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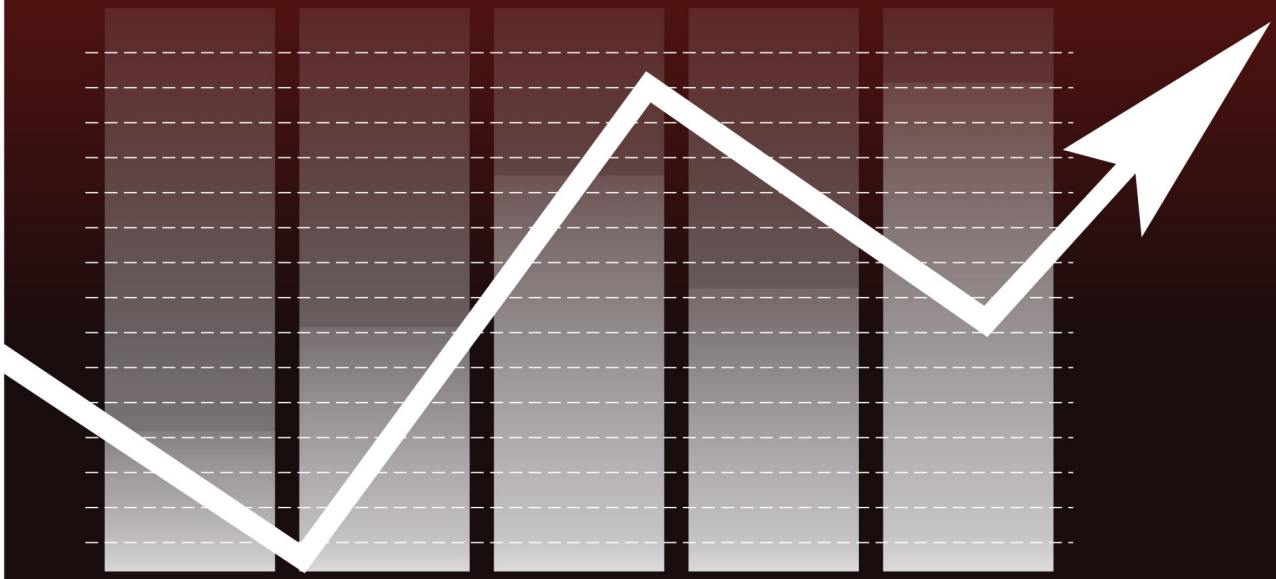

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WHEN RICH GET RICHER THERE ARISES FINANCIAL CRISIS AND BOSE-EINSTEIN CONDENSATION IN A WILD ECONOMY

Karl E. KÜRTEN[*], F. V. KUSMARTSEV[**]

Abstract. *We model one of the main laws of the wild market where rich get richer, while poor get poorer. The model reflects the main principle of the wild capitalism namely that richness attracts more richness. A fixed number of trading agents exchange and transfer money according to one main rule, when two agents are trading the money transfers from the poorer agent to the richer one. We show that in such wild market arises a new phenomenon analogous to a Bose-Einstein condensation (BEC), where many agents lose all their money. The remaining agents are fighting to become richer. With the time the condensation fraction increases; correspondingly, the number of rich or active agents decreases. The probability of the "excited" or active agents to have some money is well described by Bose-Einstein (BE) distribution. The fit is better when the trading time increases. When a majority of agents are losing all their money, the Bose-Condensation arises and the chemical potential vanishes. With growing time the condensation fraction increases. At the first stage the shape of the money distribution is well described by the Bose-Einstein one only for a low-energy/money region, while the high energy/money region is described by a Pareto power law with very large power coefficient β=12. At very later times the money distribution becomes dispersed, especially in the tail, and cannot be uniquely described by overall probability distribution. It rather covers the region in the probability-money plane, where many events happen with low probability. The boundaries of the money distribution dispersion may be also described by a Pareto power laws with different power law coefficients, larger and smaller than one. The Bose-Einstein condensation and condensate fraction growth describe a start and a development of the financial crisis, respectively. We show that this crisis may arise in different market economies when the law the "rich get richer" dominates. We argue that to stop or to avoid the financial crisis one has to remove the BE condensate, where agents are frozen from any economic activity. This may occur due to the new money flow into the market. Then the condensed agents will be excited and take again an active part in the market activity. They can again compete obeying the rich get richer law and become*

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poor. Thus, the financial crisis can be avoided if the measures to stop the BEC or to remove the Bose-Condensed fraction will be taken. Thus we may define the financial crisis as the time when the majority of population are excluded from trading or from the money exchange process. Such a view dictates direct measures what to do to avoid any financial crisis, i.e. by making active all existing economic agents.

***Keywords**: Statistical mechanics, Bose-Einstein distribution, network, condensation, complexity, financial crisis, econometrics.*

1. Introduction

It was argued that the present huge financial crisis has been triggered by a shortage of money or by a liquidity crisis and will be followed by next collapses of large financial institutions around the world. The immediate bailout of banks by national governments was an attempt to save the situation. The massive forecloses have released the money for the rest of acting economic units as well. These actions have stimulated the economy for a while however the next downturns in stock markets around the world resulted in another series of numerous evictions and foreclosures. In the present paper we introduce a model which studies such a transient process of the financial crisis. The model addresses mainly the transient periods of the financial crisis development and describes well not only the massive series of forecloses and bankruptcy started with the US subprime mortgage crisis but indicates also on its possible causes.

Although experts are placing different views on the origin of the crisis everybody agrees that two measures can help. One is the money pumping in the market, the second one is a decreasing consumer debt levels. In both cases it is very important to understand how the incoming money is redistributed or how financial cuts influence such redistribution going on during the financial crisis. In original papers by Yakovenko et al (see, Refs [1,2] and references therein and other researchers [3,4]) analysing numerous real financial data of the income revenue statistics have found that during the crisis there is a transformation of money from the poorer to the richer part of the population. The deeper the crisis the more money is transferred from poor to the rich. This finding has attracted the attention of a broad scientific community. In turn that stimulated to reconsider main concepts, which are underlining modern financial econometrics. As main players two active competing classes such as employees and employers, or industrialists and workers, or poorer and richer agents taken part in a market have been identified.

In stream of papers the search for a cause of the crisis has been focused on studies of money distribution and on a role of a debt. [5-13].

The present paper is focusing on a main principle of the market economy where are two types of players, those who own the property and tools of the production (the industrialists) and those who are providing the services (the workers), who produce goods and receive a salary for the work they done. In the model introduced here at each trading event two representatives of the above classes are taken part, one from each class. The richer one is an industrialist, while the second one is a worker. The industrialist is selling goods produced and therewith, becomes richer with each such event. The worker is buying some goods and therewith paying money and becoming poorer. The detail flow of the goods is not taken into account, and the focus is on the time evolution of money distribution. Originally any agent has a start up money as if we would assume that the salary is given only ones. And any agent can be a worker or an industrialist depending on who is richer of two trading agents. The separation is instantaneous and arises only during the trading process when richer of two chosen trading agents becomes an industrialist while the other one becomes a worker. After the trading event the rich becomes always richer. At another trading event of two agents the separation into the classes is making again. So at each trading event there is a presence of the creature such as a Maxwell Demon [14]. The Demon separates rich and poor momentarily. His decision is based on an amount of money the two trading agents have at the moment of trading. After the Demon made his decision the principle "richer get even richer" worked. This principle is playing a key role in the time evolution shape of the money distribution. We make a parallel of such an evolution with a transient period of a financial crisis. We show that after many laps or epochs of trading, there arises a transient co-existence of two states (or thermodynamic phases). One of them is similar to the celebrated Bose-Einstein condensate phase, while the other state is equivalent to a gas of free particles as those discussed in Refs [1,2] and many other papers [6-13]. The distribution of money for the second phase is described by the Bose-Einstein distribution with the vanishing chemical potential. With growing time there is a continuous transition of agents from the second excited phase into the condensate.

In our previous papers we have drawn a parallel between the financial crisis and a phenomenon of the Bose-Einstein condensation [5-7]. Such phenomenon is well studied in physics and associated with a formation of a Bose-condensate in a system of quantum gas particles known as bosons. When temperature lowers the particles are losing all their energy and dropped in a state without energy. This is well known as a formation of the Bose-Einstein condensate state, which is formed when the majority of

particles have no energy. We define a Bose-Einstein condensate state of the market when the majority of economic agents have no money. This is exactly the state of the financial crisis because in this case the agents without money cannot take part into next trading and dead for the market and economy. We propose a simple model where such a state is formed and investigate a time evolution of a financial crisis.

Thus, we found that any financial crisis is developing analogous to a formation and growth of the Bose-Einstein condensate. Such condensate corresponds to unemployed agents in very general sense that includes everything that lost income. In other words by unemployment fraction here we mean the fraction of all agents which have lost all their money and dropped out of the next trading processes. After the formation of such Bose-Einstein condensate associated with agents having nearly zero money, the shape of the rest money distribution evolves slowly. After any time period such a distribution is well described by the Bose-Einstein formulae with vanishing chemical potential. At early stages the high money region is reminiscent the Pareto tail, i.e. the power law behaviour with very larger power coefficient, $\beta = 12$. At later stages it is dispersing so that the tail covers a whole region and therefore cannot be described by any probability function. The described transient period of the financial crisis can be compared with existing experimental data, see, for example, discussions presented in the Refs. [1, 2, 3, 4, 5, 6].

2. Modelling of rich get richer trading processes

We consider a market consisting of N trading agents. At each trading event two interacting agents are chosen randomly. The choice who is the buyer and who is the seller is made with the use of the principle "rich get richer" also well known as a Law of Increasing Poverty. To implement this Law we introduce a presence of the Maxwell Demon, which decides who is a buyer and who is the seller at each trading event, where the buyer has always smaller money than the seller.

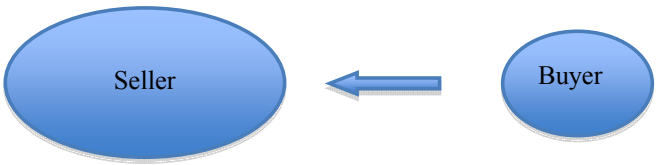


Figure 1. The scheme of each trading event performed according to the principle or Law of Increasing Poverty: "rich get richer". This means that the richer agent is always chosen as the seller and after the trading his money increases.

Initially all agents are given nearly the same or a certain slightly distinct amount of money drawn from an arbitrary probability distribution $P(t=0)$, while the total amount of money on a market is fixed and equal to M. This initial state is specifically not taken from a uniform probability distribution used in previous works [1, 2, 3, 4] since from the start we have to identify two classes: the industrialists who sell and workers who buy.

At each trading event the Maxwell Demon indicates the poorer from two randomly chosen agents. Then, for example the poorer agent i acts as a buyer, while the other richer of two chosen agents, say the agent j acts as the seller. First we assume that the amount of the transaction is proportional to the actual funds of the buyer agent i which is a plausible assumption. However the results obtained are universal and do not depend on this parameter.

Thus, in this model the wealth of the poorer i-th agent decreases as:

$$m_i(t+1) = m_i(t) - p\, m_i\,(t), \tag{1}$$

while for the j-th richer agent the money increases as:

$$m_j(t+1) = m_j(t) + p m_i\,(t), \tag{2}$$

where the parameter $p(0<p<1)$ indicates the fraction of the funds transferred during the purchase.

3. Concept of Bose-Einstein distribution of money and a condensation of agents without money

Next we study the time evolution of the money distribution. We call a time period of N interactions, where each agent has taken part in trading twice on average as one epoch. Interestingly that for each time period, after any fixed number of epochs, a probability of some agent to have the money, m, can be consistently described by the Bose-Einstein distribution which is naturally arises from an application of statistical mechanics to economics [5]. Such an application was based only on assumption that market is chaotic and therefore an ergodic hypothesis can be applied. This results in a next consideration of various ensembles consisting of time snapshots of the market taken after different time periods. The finding of the probability for the most optimal configuration of the market provided its statistical description. Considering a market as grand-canonical ensemble where number of active agent may change, for example, due to a bankruptcy of agents when their lost all their money and become inactive for the market. Within such an approach the most general distribution for

the market has been emerged and it has a form very close to a Bose-Einstein distribution, which is conventionally used in Physics for a description of gas consisting of quantum Bose particles. What is a common between these two very different systems, in physics and economics?

The commonality is in fact that any agent may have the same amount of money or income as any other agent, that is, this is equivalent that any number Bose particles can occupy the same energy level. Moreover, agents having the same money economically indistinguishable as Bose particles having the same energy and this results in their statistical similarities (see, more details in Ref. [5]).

Note, that this is a pure statistical description and analogy that provides interesting consequences for the market. For example, at some conditions as very low temperatures the gas of Bose particles may have two states: 1) a BE condensate consisting of particles with zero energy and 2) a gas of the rest particles having non-zero energy. When temperature decreases there is a transformation of particles from the active part into the condensate.

Indeed, in the present model of the market we found that exactly such a situation arises. With the growing time the agents are separating into the condensate and active group consisting of trading agents. The condensate fraction is growing with time while the number of active agents decreases. In general, for any value of the parameter p the time evolution of the initial money distribution seems to relax very fast towards a time dependent probability density distribution, which is consisting of two parts: 1) the condensate and 2) the one having the form of the Bose-Einstein distribution:

$$P_{BE}(m) = \frac{n_0}{\exp\left(\frac{m-\mu}{T}\right)-1} \tag{3}$$

where n_0 is a normalisation factor, μ is a chemical potential and T is a temperature. Our studies show that the time dependence for chemical potential, μ, and its value vanishes very fast with a few epochs from a start of the market operation, even for small values of p. Then, the BE condensate is formed, while the money distribution of the active agents ($m>0$) is described by the same equation (3) with $\mu=0$. When $m-\mu << T$ the distribution is simplified to the power law form:

$$P(m) = \frac{n_0 T}{m-\mu}. \tag{4}$$

At initial stage, when the number of epochs is not very large, there, in the high energy/money part, arises a Pareto tail that can be approximated by the Pareto power law specified by the probability distribution of the form:

$$P_{Pareto}(m) = \frac{c_0}{m^{\beta}}, \tag{5}$$

where the parameter β specifies the power law coefficient, while c_0 is a normalisation constant. Interestingly that for the case when $m < T$ the equation (3) is reduced to a power low which is obtained by a Taylor expansion of the BE distribution function in the vicinity of the $m = 0$, *see the eq*. (4). In this case the power law coefficient is $\beta=1$ and $c_0=T\,n_0$.

First we would like to consider the limiting case, when $p = 1$, which allows to obtain exact mathematical result illustrating the concept discussed. Here each buying agent (a worker or it can be even a poorer bank) is spending all his money in each transaction, while the money of an industrialist increases. As the result the worker (or poorer bank) is losing all his money and after that is expelled from the next trading processes, i.e. from the market. That is, the poorer bank has $m_i(t+1) = 0$ *and he is bankrupt* after the first time step. At the same time each seller (the industrialist or the richer bank) is gaining that is $m_j(t+1) = m_j(t) + m_i(t)$. Thus, the seller absorbs the whole fortune of agent *i*. After $N/2$ trading events half of the agents will lose all their money. Following above we may call them a condensate. The rest, active agents will have some money that will depend on money initial distribution. When number of trading events increases and become equal to *N*, i.e. after one epoch all banks except one vanish and all the money will be in the hand of this one single agent. Note all other banks have no money, that is we may call they all are in Bose-condensed state, which in a physical system corresponds to the state where particles have no energy. The phenomenon of the formation such a state, where the majority of particles have no energy (or banks no money) is called the Bose-Einstein Condensation (BEC). Here, nearly complete (BEC) condensation happened during one time period – one epoch. There all agents are in the condensed state (except one richest bank- "the winner takes it all").

Now, we show that the BEC is formed in other cases when the parameter $p<1$. In this case the formation of the BE condensate is significantly slow down. Then, practically all agents have many trading events before losing all their money and therefore there is enough time to form a BE money distribution of the rest active agents. Below we study

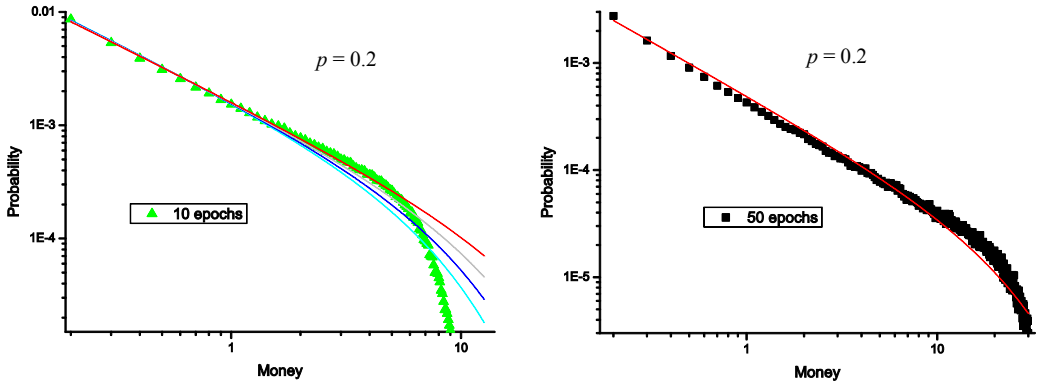
numerically how the distribution of money evolves after some time period where all agents have taken part in the trading processes many times. The temporal evolution or the specific values of described parameters of the money distribution depend strongly on the rate of the money exchange, that is, on the value of the parameter p. They also depend on the topological structure of the financial trading network, but this issue we postpone to discuss to a later stage. We note that our trading network is equivalent to a gas of particles [1,2,3]. In this analogy each trading agent represents a particle. Then the trading processes of the economic agents are equivalent to the exchanging energy of the gas particles, which occurs in mutual collisions. However, the economic system differs from gas particles, by the presence of the Maxwell Demon which directs the energy/money transfer between two particles at their collision. In other words to implement the law "rich get richer" at each trading event we have to introduce the "creature" similar to the Maxwell Demon well known in thermodynamics. The creature has extra information which particle has higher energy/money and therewith indicates the direction of the energy/money transfer from the lower energy/money particle/agent to the one having higher energy/money and also controls the fraction of the energy transfer.

4. The fitting of distribution of money with the Bose-Einstein formulae

Thus, there are double reasons why the *BE* distribution should fit the data well. First because the same amount of money may have many agents and they are financially not distinguishable. The second is that the agents may leave the market when they lost all their money. Since condensed agents are not active the number of trading agents decreases and at the same time they become richer, in average. When p is very small the process is very slow. When the value p increases and becomes larger the condensate fraction and the temperature of the BE distribution's of active agents increase dramatically with growing number of epochs. At such transient process the Boltzmann exponential distribution practically does not appear. The money distribution can be described by universal fitting formula, as Bose-Einstein distribution, see, eq. (3).

For example, for a market consisting of 1million trading agents the money distribution recorded after 10 and 50 epochs is presented in figure 2, where the trading fraction was taken as, $p = 0.2$. For the case of 10 epochs we present four different fitting curves, in cyan, blue, grey and

red colours, obtained with the use of eq. (3) with the usage of the fitting parameters: the temperature, T =3.8, 4.9, 6.8, 11.1 and the constants, $10^7 \cdot n_0$ = 45,35,25,15, respectively. The fitting value of the chemical potential is equal to μ=0 in all cases. Note that for all these curves the product Tn_0 is fixed and is approximately equal to $17 \cdot 10^{-6}$. When the fitting temperature T rises from T =11.1 the fitting curve is transformed in a straight line associated with the power law behaviour, $P(m)= 17 \cdot 10^{-6}/m$, that perfectly fits the upper part of the data. The similar situation arises for the data recorded after 50 epochs. However, already in this case we are able to find such values of fitting parameters that all data can be described by a single analytic curve associated with the Bose-Einstein distribution, eq. (3), see, for example, the red curve presented on the Figure 2*b*. There, the values of fitting parameter are taken as T =13.6 and $n_0 = 37 \cdot 10^{-8}$. With larger number of epochs and larger values of *p, all money distribution data can be always fitted by a single BE distribution.* Of course, the condensate point is excluded from the distribution and therefore it has not been shown on the Figure 2.



a) *b)*

Figure 2. The various fits of the money distribution for a state of a market consisting of 1million trading agents recorded after a) 10 and b) 50 epochs, when the trading fraction, p = 0.2. All solid coloured lines correspond to the Bose-Einstein distribution function (see, eq. (3)) for different values of parameters, T and n_0 but for the fixed value of the chemical potential equal to μ = 0. For a) the coloured fitting curves (cyan, blue, grey and red) correspond to the temperatures, T = 3.8, 4.9, 6.8, 11.1 and the constants, $10^7 \cdot n_0$ = = 45,35,25,15, respectively. Note that for each of this curve the product Tn_0 is fixed and is approximately equal to $17 \cdot 10^{-6}$. For b) the red curve corresponds to T =13.6 and $n_0 = 37 \cdot 10^{-8}$. The comparison a) and b) indicates that with increasing number of epochs all money distribution data can be fit with one Bose-Einstein distribution function with μ = 0. The point associated with the Bose-condensate fraction, which is inherent to the case, has not been shown on the Figure.

If we compare the found distribution with analogous model in physics, say a gas, then, this gas must be considered as a quantum gas and will consist of boson particles at temperature T. Its spatial dimension is unknown. The parameter n_0 will correspond to a normalisation factor that can be chosen to fit the BE distribution function for a quantum Bose gas particles. In this analogy the parameter μ will correspond to the chemical potential of the system consisting of these bosons. In the discussed model the value of μ vanishes very fast with the time and the condensate fraction formed. The detail results of numerical experiments are presented in the next section.

5. Analysis of numerical experiments and simulations of the wild market evolution

In numerical modelling presented below we have considered a market with $N = 10^5$ and 10^6 trading agents.

The results obtained in both cases are similar and universal. For the first case, when the value p is small all agents spend only a small fraction of the capital they have, i.e. they are very cautious to spend too much. As a result with number of epochs the distribution of money is changing slowly, one may say adiabatically. Specifically, when the parameter $p = 0.2$ after the time periods of 10, 20, 50 and 100 epochs the simulated money distribution is presented in the Figure 3, below.

The lower energy/money part is also well fitted by the Bose-Einstein (BE) distribution, $P(m) = n_0/(\exp(m/T) - 1)$ provided that T is larger than the crossing temperature T_{cross}, ($T > T_{cross}$). In this case the BE function can be approximated a power law with a power 1: $P(m) \approx Tn_0/m$. While the product Tn_0 is a constant for each set of data, inversely proportional to the number of epochs, N_{epochs}, the value of one of the two parameters, T or n_0, can be chosen arbitrarily, provided that T is larger than T_{cross}. The value of crossing temperature, T_{cross}, *turns out* to be roughly proportional to the number of epochs, N_{epochs}. The data of the high-energy/money tail is strongly dispersed. The dispersion increases with the value of the parameter p and the number of epochs. However when teh dispersion is not very large for small number of epoch as and p they may be equally well described by the celebrated Pareto Power Law, which is presented by straight lines with very steep slope, where the power coefficient, β~12.

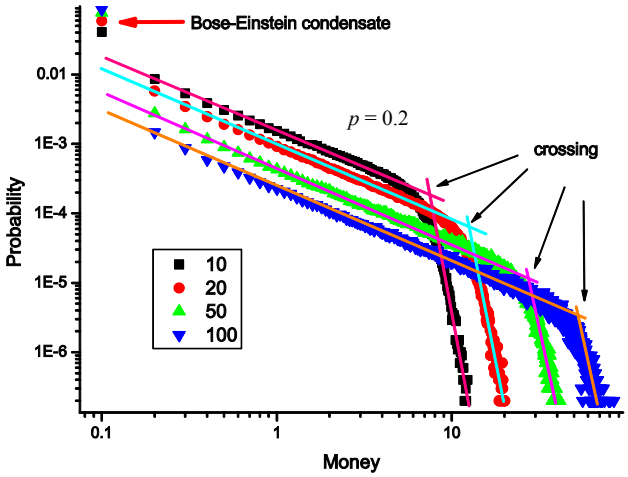


Figure 3. The time evolution of money distribution recorded after 10, 20, 50 and 100 epochs of the free market, where 1 Mln. agents are trading the fraction, $p = 0.2$, *of their money. The data are* presented by black, red, green and blue symbols for 10, 20, 50 and 100 epochs, correspondingly. The vertical and horizontal axes correspond to the frequency (or the probability) and the amount of money the agents have, respectively. Each set of data may be conventionally separated into three groups, the lowest or "zero", low and high energy/money parts. The first bin is zero energy/money. It covers those agents having the smallest amount of money, close to zero. For the most of the evolution time the majority of agents belongs this bin. The other two parts (low and high energy/money groups, of the data can be fitted by straight lines in the logarithmic scales that specify power law distributions. These two groups are separated by the value of money which we call as the crossing temperature, T_{cross}, which is equal to the value of money associated with the crossing of two lines associated with the same number of epochs and is indicated by black thin arrows with notation as "crossing".

From the Figure 3 we see that for all different time periods the numerical data are grouped into three sets: the "zero" or lowest money point and two other groups which may be characterised by straight lines with different slopes. The group of "zero" money points is indicated by arrow as Bose-Einstein condensate. In the double logarithmic plot the straight lines correspond to the power law distributions. The different coloured lines of low money region correspond to different times of the market expressed in a number of epochs. For all times the money distribution is described by the same BE equation which can be expressed in the power low distributions with the power coefficient, $\beta=1$ and $\beta=12$, for low and high money region respectively. At very large number of epochs, $N_{epochs} >> 100$, the separation into two power law distributions vanishes.

The first group of "zero" money points corresponds to agents who lost all their money and it is located separately. With the time the probability to

find more and more agents in this bin increases (see, the Figure 3) where the first point (bin) corresponds to the condensate. This point describes a probability of agent's bankruptcy or a probability of agents to lose all their money. With growing number of epochs this probability rises (see, Figure 3). Very consistently that at the presence of the condensate the money distribution of rest active agents is well described by the BE eq. (3), when the chemical potential vanishes. In low money region the BE eq. (3) may be well replaced by equivalent power law distributions, see the straight coloured lines on the Figs 3 and 4, where the money distribution data for the cases with $p = 0.2$ and $p = 0.5$ are fitted, respectively.

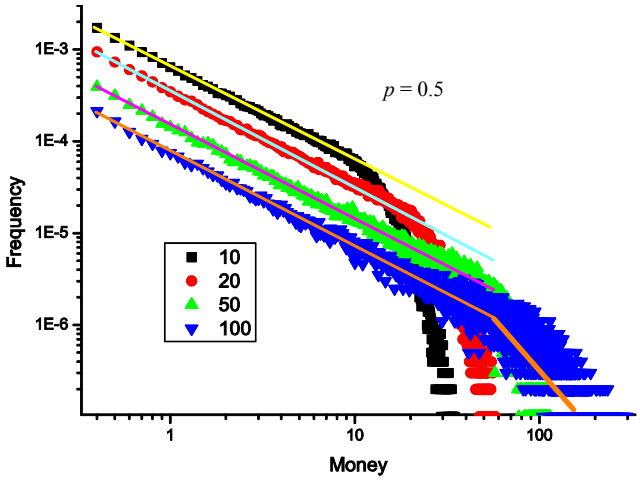


Figure 4. The distribution of money for the market where 1 million agents are trading a fraction of p= 0.5 of their asset in each event. The data have been recorded after 10, 20,50 and 100 epochs and noted by black, red, green and blue symbols respectively (see, Fig. 3, for a comparison, where the case with p=0.2 presented). Here, the first group of zero points, associated with the BE condensate, have been excluded from the graph. The lower energy/money part is well described by BE distribution, the eq. (3), with the activity parameter $a = exp(\mu)/T$=1.00 at any arbitrary temperature provided T that $T > T_{cross}$. For this low money region the BE equation may be approximated by the power law with the fitting constant – the product Tn_0. Then the frequency (or a probability) of agents to have the amount of money m is obeyed the power law: $P(m) = Tn_0$ /m, where the value, Tn_0, depends on a number of epochs N_{epochs}. It is inversely proportional to N_{epochs}. The second high energy/money part may be well described by a Boltzmann distribution or a Pareto power law, where $P(m) \sim 1/m^{12}$ (see, the coloured straight lines with steeper slope). Plotted in the logarithmic scale one may clearly see the changes of the distribution shape arising in the region of large money. The lower energy part is well described by BE distribution associated with the state with the BEC, which are fitted by yellow, cyan, magenta and orange lines, described by the eq. (3) with μ=0 and the temperature $T > T_{cross}$.

When the value of the parameter, p, increases further the evolution of the money distribution and the formation of the Bose-Einstein condensate is going faster, see, for a comparison, the changes in the money distribution for p=0.2 and p=0.5 presented in Figs 3 and 4, respectively, where the money distributions of active agents recorded after 10, 20, 50 and 100 epochs are given. The behaviour of the money distribution, for p= 0.5, is very similar to one described above for the case p = 0.2. At all times they are well described by Bose-Einstein distribution with μ= 0. In addition there arises a high-money tail, which at small values of p and small number of epochs may be equally well described by Pareto power law or by exponential (or the Boltzmann) distribution. The condensate fraction grows here (for p = 0.5) faster than in the case, p = 0.2 (see, Figure 5). In the low money region the BE equation may be replaced by its Taylor expansion expressed as the power law, $P(m) = Tn_0/m$. The results are universal and do not depend on the size of the market. For example, for the smaller market consisting of 10^5 agents the distribution of money recorded after 100 epochs is also described by BE or the power law with the fitting constant, Tn_0=0.006.

5. The growth of the Bose-Einstein condensate fraction with time

In general we noticed that when the parameter p increases the formation of the Bose-Einstein condensate is going faster and faster, see Figure 5. First question arises: what is the origin of this BE condensate. Such condensate is nothing but a set of unemployed people or bankrupt banks.

We have shown on the Figure 5 that the growth of the condensate fraction is well described by the power law as:

$$n_{condensate} = 1 - \frac{n_0}{(t + t_0)^{\alpha}}. \qquad (6)$$

The values of all the parameters, n_0, t_0 and α, depend on the parameter p, which control the amount of the money fractions transferred at each trading event. The found power law has an intimate relation with the Pareto distribution arising in the last income region. Obviously the power law as $n_0/(t+t_0)^{\alpha}$ indicates on a very slow growth of the zero income population associated with the long term evolution of the market. The condensate corresponds to agents who lost all their money and therefore without money they are not active and dead for the economy. The rest, who left, are intensively trading to become rich. But here the law rich get richer is working and unavoidably some agents losing constantly their money, i.e.

they are eventually end up in the condensate. Effectively this law "rich get richer" means that there is a serious battle to stay "alive" and become richer and richer. The final destination of this game is complete condensation, where all agents except one (the "winner takes it all") are collected in the dead condensate.

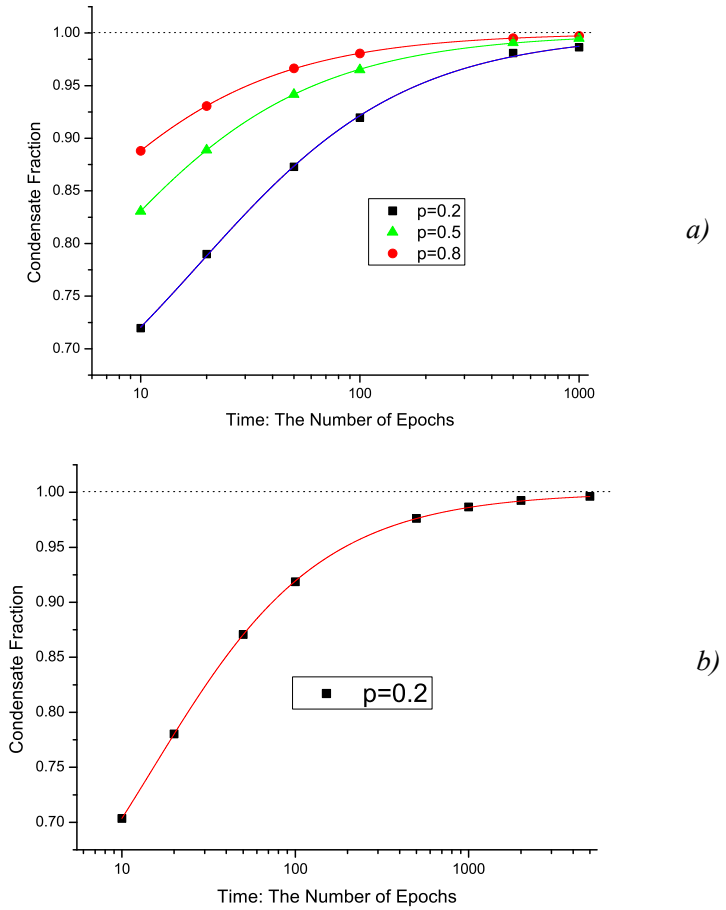


Figure 5. a) The evolution of the condensate fraction with the time for three models associated with the parameters $p = 0.8$ (black), $p = 0.5$ (red) and $p = 0.2$ (blue). The numerical data are presented by points. The smooth curve is a fitting with the function $m_{fraction}(t)=1- n_0/(t + t_0)^{\alpha}$, where the parameter α is weakly depend on p. It is equal to 0.8 for $p = 0.2$, 0.81 for $p= 0.5$ and 0.86 for $p= 0.8$. The dependence on p other fitting parameters as t_0 and n_0 is also not very strong. So we have here t_0 =12 and $n_0 = 3.55$ for $p = 0.2$, $t_0 = 4.84$ and $n_0 = 1.5$ for $p= 0.5$ and t_0 =3.4 and $n_0 = 1.05$ for $p = 0.8$. So the growth of condensate fraction with time is going on via a power law, which is very slow. The approaching to a complete condensation may happen only at infinite long time, where the condensate fraction $n_{condensate}(t = \infty) = 1$. b) The growth of a condensate fraction for the case $p = 0.2$ presented on a longer time scale, up to 5000 epochs, indicating a perfect fit with the given equation.

7. A dispersion of the money distribution at long time scales

The financial market is chaotic. This forms a basis for an application of statistical methods and statistical mechanics [3] that provides a specific form for its money distribution. Indeed, in a line with these ideas we found that money distributions in many financial systems can be described by appropriate distribution functions, see for example Refs[1-6]. However, studying here the market evolution where a *Law of Increasing Poverty* operates, which we connected with the state of the market at a financial crisis, we found another new phenomenon – this is the dispersion of the money distribution. Numerical experiments indicate that at very long time scales, after many epochs $N_{epochs} >> 100$, the frequency at which agents may have a smaller and larger money may be equal, ie this happen with the same probability. For example, for the market with $p = 0.5$ after 500 epochs with a frequency one from a set of one million agents have the money in a range from 50 to 5000 relative units, see Figure 6. This effectively indicates that many rare events accumulating in the money distribution are responsible for the dispersion. From other side agents may have also large money, with large and very small probability. In other words the distribution function occupies a whole region in the probability-money or frequency money plane (see, the Figure 6 where the money distribution data recorded after 500 and 1000 epochs are presented).

Thus the money distribution recorded after a very long time as 1000 epochs occupies a region in the frequency money plane, see Figure 6. The results have been obtained with the use of numerical experiments. Moreover we found that after such a long time the whole money distribution (or the whole dispersed region) is consistent with the same Bose-Einstein form where the chemical potential vanishes. Here the largest part of the agents has no money, i.e. they form the BE condensate state. However the money distribution of active agents is strongly dispersed. The dispersion increases when the amount of money increases. Effectively this means that some large amount of money may occur very rare but some other nearly the same money with very high probability, see c) where some small region in the money tail, $90<m<100$, is zoomed. In other words the data accumulate many very rare events and effectively correspond to some chaotic dynamics of the market. From one hand this justifies the usage of ergodic hypothesis and methods of statistical mechanics which predicted the Bose-Einstein distribution of money [3]. On the other hand the growing dispersion indicates that the tail of the money distribution cannot be fitted by a single unambiguous curve but rather a region in the money-frequency plane.

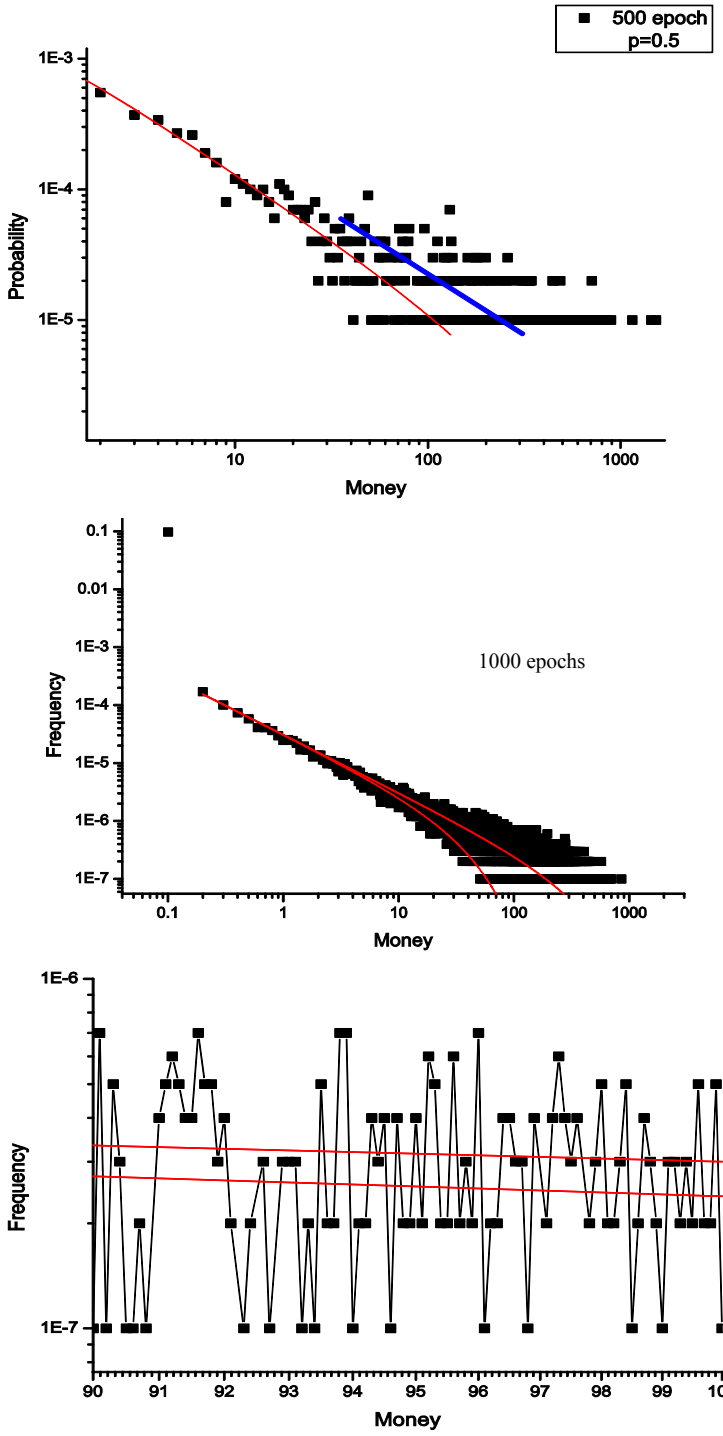


Figure 6. The distribution of money recorded after 500 epochs for the market when the parameter, $p = 0.5$. In the logarithmic scale used here one may clearly see the rise of fluctuation towards the region of larger money. In

spite these fluctuations or an appearance of rare events one may see that the whole energy/money spectrum is well described by the BE distribution associated with the formation of the BEC state (see, the red curves, described by the eq. (3) with μ=0). a) The used fitting constant is $n_0 = 6 \cdot 10^{-6}$ and the temperature is $T = 237$. All data may be also well described by the Pareto power law, $P(m) = Tn_0/m$, that coincides with the same red line, where the fitting constant is the product: $Tn_0 \approx 0.001422$. It may be equally described by other larger fitting constant (see, the blue straight line). These fluctuations in fact correspond to some rare events happen with the frequency equal to one in a whole market history. Due to such rare events it is too difficult to give a definite answer about precise money distributions when the number of epochs is very large as 1000. Due to these rare events the data are strongly dispersed and therefore it is impossible to fit them by a single ambiguous curve. We believe that this dispersion is an intrinsic feature of any market associated with its chaotic behaviour where any agent may have any amount of money although it may be a very rare event. Comparison of the distributions recorded after a) 500 epochs for the $p = 0.5$ and b) 1000 epochs for $p = 0.2$ indicates that they are not much different have a very strong dispersion in both cases. We also present two BE curves (in red) which correspond to the same product $Tn_0 \approx 2 \cdot 10^{-4}$, but different temperatures, $T = 20.5$ and $T = 205$, for the left and right red solid curves on Fig. 6I), respectively; c) The same as on b) but zoomed in the region where 90<m<100 and line is connecting the data points just for a guide for eyes. One sees here that the distribution in the tail cannot be approximated by analytic function. The red lines are the Pareto power law fits.

In summary we found that when the parameter p describing a fraction of the buyer money used in a financial transaction increases the value of the chemical potential vanishes faster with each epoch and faster growing the condensed fraction. Then more economic agents are losing all their money and form the Bose condensate. Agents in the Bose-condensate are not active and practically dead for the next market evolution. This is exactly the state of financial crisis. Note that this condensation of agents is different from a condensation of links or connections, discussed previously in a context of complex networks [15-17]. The rest, the active agents, who still have money, do continue trading, while their number decreases significantly with each new epoch of the crisis evolution.

8. Financial crisis and the condensate formation

In the present paper we have studied a simple model of the financial crisis considering a fixed number of N economic agents interacting and trading in pairs. We have implemented the law of the “rich get richer” and considered the evolution of such a market. For a starting, original

distribution of agent's money, we assumed that all agents have slightly different amounts of money with equal probability. The different initial distributions of money give the same results. There with the growing time arises a separation of agents into groups or classes. The first largest group of the financial crisis is condensed agents who have no money. Their number increases with time. The second group is active agents whose number decreases with each new epoch of the market evolution. With the time the probability of active agents to have an amount of money m, the quantity $P(m)$, named as the money distribution reaches some universal shape, which may be well described by the Bose-Einstein distribution. The financial transactions between agents have been described by the parameter p, which effectively characterises a money turnover of the market for a certain time period. We studied the time evolution of the money distribution between agents when the parameter, p was fixed to different values, between 0 and 1. The most interesting finding is that the development of the financial crisis is equivalent to a growth of the Bose-Einstein condensate. The existence of the described phenomenon does not depend on a specific value of p, while the rate with which the Bose-condensate grows does.

The small values of p correspond to a market where trading is limited by transactions associated with small amounts of money in a comparison with an amount money which each buying agent is spending in a trading process. In such a case of the "safe market economy", even although agents are very cautious to use all their money in a single trading event they still are losing their money because of the power of the "rich get richer" law. At large p agents use the largest part of their money in their individual single trading processes. There the amount of the condensate increases with time very fast. But in all cases when the condensate has been formed we found that the shape of the money distribution does not depend on anything and takes the universal Bose-Einstein distribution form with vanishing chemical potential.

For small values of p, as $p = 0.2$, at early stage of the market, we noticed another new phenomenon – a separation of the active part of the market (the active agents) into two classes, of low and of high incomes. The Bose-Einstein distribution emerges with the market evolution from the low class. It fits well along a very long time, although the parameters of the distribution changes. The money distribution however, seems, is splitting, explicitly down into two regions or two scales: the region associated with small money values and the second one – the high money region. Thus, the

system is effectively decomposed into two classes having the lower and the higher incomes even if we have not taken into account the Bose condensate. The low class is described well by traditional Bose-Einstein distribution, where the associated market temperature, *T,* changes with time while the chemical potential μ remains zero. The high class is described by Pareto power (see, also the Refs [1-4]). With the time the tail in the money distribution is dispersed and the boundary threshold separating money of both classes vanishes. There a qualitative crossover of the Bose-Einstein distribution and the scale free one emerges. The creation of the Bose-Einstein distribution of money has been recently derived on the basis of an application of statistical mechanics economics and reveal in USA revenue income data [5].

There the free economy market was considered as a complex system displaying a chaotic behaviour. Taking into account this fact an ergodic hypothesis has been used. As a result statistical ensembles of the market snapshots have been built up. Then the most optimal distribution of money on such a market has been revealed to have a very general Bose-Einstein distribution form. When the average money of agents is much larger than the chemical potential of the market, the distribution takes the celebrated Boltzmann form. Analogous, although different applications of statistical mechanics and models with Boltzmann form of money distribution have been presented in a series of papers, recently [19-29].

The decreasing ratio of the fitting parameters $|\mu|/T$ means the motion of the economic system towards financial crisis [5]. Here, we have shown that the development of financial crisis is a time dependent formation of the Bose-Einstein condensation. Although it was noticed earlier that the Bose-Einstein Condensation phenomenon could arise during the financial crisis [5], its development and consequences have not been studied. The formation and evolution of such condensate consisting of non-active ("dead") economic agents as a form of financial crisis has been described here for the first time. Contrary to the financial crisis associated with a formation of the (BEC) condensate and an economic growth of human society and an exit out-of-recession can correspond to an activation of the "dead" agents. In a process of such activation their number in the condensate decreases and they again have a new life to trade and to support the economy. Thus, we have here shown that for the "rich get richer" principle known as a Law of Increasing Poverty, the crisis arises very fast, in a few epochs from the start of the market operation. During the crisis most of the agents are in the BEC ground state, which is different from the

active trading state in which the rest of the agent, do exist. The condensed agents with zero money may be activated by debt, although this may lead to other problem or by luck or fortune when they will sell some product successfully.

Summary

We have described a wild market economy where the majority of economic agents are losing their money and dropped in a state without money. We call such a state of economic agents as Bose-Einstein "condensate" that reminiscent BEC state existing in physical systems. When this happens the number of agents who have no money, i.e. in the BE condensate, is of the order of the total number of agents, *N*. There is no here a strict phase transition into the BE condensate, but rather a crossover. The money distribution of the rest active agents has been identified by fitting as a Bose-Einstein one with zero chemical potential. Such a condensed state has been created after some period of time expressed as a fixed number of epochs.

The excellent fitting of the BE money distribution and the formation of the BE condensate on a market where a financial crisis developing confirm the general idea that market should be described with the use of statistical mechanics and with BE distributions.

In conclusion, we have considered a simple model of a free market economy which operates according to a rich get richer law. We have demonstrated that such market leads directly to a financial crisis associated with a formation of a new condensed state. In such a state a numerous agents lost all their asset and dead for the next market operations. We shown that for any market parameters chosen such as a number of agents, the amount of money or the fraction p of money used in the financial transaction the trading on this market is very risky. The market evolution unavoidably leads to a formation of the Bose-condensed state where a significant fraction of economic agents lost their money forming the Bose-condensate. The next participation of these agents in the market is prohibited unless they will loan the money and receive the debt or be very lucky to inherit wealth. In such a market poor people get poorer and poorer. At the long term there are always left a few rich people on the market, i.e. having a lot of money, who are trading between each other-finally "the winner takes it all". While the majority of population forms the condensate who is not trading because it has no money. Because the

condensate has nothing to do financially it can become politically or otherwise active and violent as recent riots in London. The government should take care to stop the growth of the condensate, this is a very important.

In next we plan to consider the generalisation of this model market with debt and salary which awake dead agents and increase a population of the active ones.

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APPLICATIONS OF THE SECOND ORDER PERTURBATIONS THEORY AND THE GREEN FUNCTION METHOD TO THE ECONOMIC UNITS

Sever SPÂNULESCU*

Abstract. *A set of similarities between an economic unit and an atomic system are drawn and the corresponding quantitative relationships are established. As some of the most important atomic processes are successfully studied in the framework of the Quantum Electrodynamics, the present work proposes applying some of the specific mathematical instruments of this domain to the economic studies, in particular the perturbations theory and the Green function method. Based on the analytical formulae obtained for the photoionization, some conclusions concerning the probability of migration of the employees from an economic unit are claimed, mainly the peculiar phenomenon of the probability of migration decreasing when the external offer increases.*

Keywords: *quantum electrodynamics, Hamiltonian, actual value operator, perturbations, Green function, photoionization.*

1. Introduction

The complexity of the economic systems involves often some very difficult mathematics, most of them having analytical solutions only for very simple models that cannot supply realistic solutions. Some specific approximation methods for solving the equations associated with complex models have been developed, especially for the cases involving partial derivative equations and nonlinear terms [1, 2]. Taking into account that the economic systems usually display a high synergy, it is expected that a realistic model has to be a self-consistent one, in which every part is influenced by all the others, so that any calculations have to be conducted in an iterative way.

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This situation is also met in the atomic systems, where all the parts (electrons and nuclei) are evolving in an overall field generated by each of them – the self-consistent field [3-5]. The interactions of such systems with the exterior are well studied using the methods of the quantum electrodynamics (QED) [6] and quantum mechanics. Remarkable progresses were made in the last decades for approximately solving the huge systems of differential equations that arise in such calculations and several efficient mathematical methods have been specially developed for these particular fields [7-9].

2. An atomic model of an economic unit

In a similar way that we describe the evolution of an electron bounded in an atom, we may describe the activity of one employee as a function $\psi_n(\mathbf{x})$ whose absolute square $|\psi_n(\mathbf{x})|^2$ indicates the influence (or the value) of that particular employee in various zones of the institution. The variables that compose the vector $\mathbf{x}$ are specific to the respective institution so we shall treat them as generic. For a short enough period of time the system may be considered as stationary, so that the variables vector does not include time. In this steady state form, the employees have specific values for the institution, E_n which belong to a discrete set, similar to the quantified values of the energy for atom bound electrons.

Let us consider an institution *A*, with an overall value Z_{eff}, whose function chart contains *n* levels, each of them described by an eigenvector $\psi_i(\mathbf{x})$, forming the set $\{\psi_1(\mathbf{x}), \psi_2(\mathbf{x}), ..., \psi_n(\mathbf{x})\}$, where $\psi_1(\mathbf{x})$ is the most important function, and $\psi_n(\mathbf{x})$ the least important. Each level is occupied by one or several employees. The institution has a number of *N* departments, where each employee has a certain value $|\psi_n(\mathbf{x})|^2$, according to his attributions. The relationship between the functions $\psi_n(\mathbf{x})$ and the values E_n may be written as an eigenvectors and eigenvalues problem, in a similar way as the time independent Schrodinger equation:

$$H\psi_n(\mathbf{x}) = E_n\psi_n(\mathbf{x}). \tag{2.1}$$

In this equation $\psi_n(\mathbf{x})$ are the eigenvectors and E_n the eigenvalues of an operator *H*, which may be interpreted as the Hamiltonian of the system. The macroeconomic theory deals with this type of operator (mainly used in physics) for the economic systems as the actual value operator [10, 11].

Among the many powerful mathematical tools dealing with such operators, we shall focus on the perturbation theory [6], which may successfully describe the interactions of the atomic system with the exterior and the modifications that may occur, especially in the scattering theory. Some elementary processes are quantitatively well described in the framework of QED using the perturbation theory, using the self-consistent field method [3, 4] or the Green function method [6]. We consider that some of the major mathematical techniques involved by this approach in physics may be ported to the economic systems theory, and the present paper marks our first attempt in this direction.

Thus, we shall refer to the photoionization of the atoms, an inelastic process involving the perturbation of the atomic structure by an incoming photon which leads to the eviction of an electron. A similar situation may be observed in an economical unit, when an external perturbation may lead to the dismissal of an employee (either wanted or not). In fact, in QED, the perturbation may lead to the removal of an electron with a certain probability, and the noticed magnitude of the process is described by its effective cross-section, which describes the likelihood of actually producing the effect. It may be calculated from the matrix element of the process, which is obtained as an approximation by the perturbation theory [7, 8].

The standard procedure for obtaining the matrix element in QED is to develop at total Hamiltonian of the perturbed system in a power series including the unperturbed system's Hamiltonian and the first order perturbation, the second order perturbation and so on:

$$H = H^{(0)} + \lambda H^{(1)} + \lambda^2 H^{(2)} + ... \tag{2.2}$$

Here, the unperturbed system's Hamiltonian satisfies the Schrodinger equation for every unperturbed eigenvector and eigenvalue:

$$H^0 \psi_n^0 = E_n^0 \psi_n^0. \tag{2.3}$$

Then, one considers that the perturbed system's eigenvector and eigenvalue may be expressed in similar terms, containing the various order perturbations:

$$\psi_n = \psi_n^{(0)} + \lambda \psi_n^{(1)} + \lambda^2 \psi_n^{(2)} + ... \tag{2.4}$$

$$E_n = E_n^{(0)} + \lambda E_n^{(1)} + \lambda^2 E_n^{(2)} \tag{2.5}$$

and the perturbed system obeys a similar eigenvectors and eigenvalues equation:

$$H\psi_n = E_n\psi_n. \tag{2.6}$$

Plugging in the expressions (2.3)-(2.5) in (2.6) we obtain:

$$(H^{(0)} + \lambda H^{(1)} + \lambda^2 H^{(2)} + \lambda^3 H^{(3)} + ...)(\psi_n^{(0)} + \lambda\psi_n^{(1)} + \lambda^2\psi_n^{(2)} + \lambda^3\psi_n^{(3)} + ...) =$$

$$= (E_n^{(0)} + \lambda E_n^{(1)} + \lambda^2 E_n^{(2)} + \lambda^3 E_n^{(3)} + ...)(\psi_n^{(0)} + \lambda\psi_n^{(1)} + \lambda^2\psi_n^{(2)} + \lambda^3\psi_n^{(3)} + ...). \tag{2.7}$$

Now, the key of the approximation is to limit these infinite expansions to a certain order, according to the desired precision goal and thus simplifying the overall calculations. In practice, one may retain the first two terms (and obtain the results in the first order of the perturbations theory), or the first three terms (obtaining the results in the second order of the perturbations theory).

For simplicity, we shall illustrate the method for obtaining the matrix element by referring in the following only to the first order perturbation theory. The eigenvectors and eigenvalues equation (2.7) becomes:

$$(H^{(0)} + \lambda H^{(1)})(\psi_n^{(0)} + \lambda\psi_n^{(1)}) = (E_n^{(0)} + \lambda E_n^{(1)})(\psi_n^{(0)} + \lambda\psi_n^{(1)}). \tag{2.8}$$

By identifying the terms in λ in both sides of the equation we obtain:

$$H^{(0)}\psi_n^{(1)} + H^{(1)}\psi_n^{(0)} = E_n^{(0)}\psi_n^{(1)} + E_n^{(1)}\psi_n^{(0)}. \tag{2.9}$$

For further calculations we shall adopt some usual conditions for the Hamiltonian operator and the eigenvectors, considering them as parts of a Hilbert space and defining the scalar product specific to this kind of space. By using the bra-ket notation for the vectors and denoting with $|n_i\rangle = \psi_n^{(i)}(\mathbf{x})$ the function ψ_n in the order i of the perturbation, we may write:

$$\langle n_i \mid n_j \rangle = \int_D \psi_n^{(i)}(\mathbf{x})\psi_n^{(i)*}(\mathbf{x})d\mathbf{x} = \delta_{ij} \tag{2.10}$$

where we considered that all the vectors form an orthonormal system and $\psi_n^{(i)*}$ is the complex conjugate of the function $\psi_n^{(i)}$.

With these notations, equation (2.9) becomes:

$$(H^{(0)} - E_n^{(0)}) \mid n_1 > = (E_n^{(1)} - H^{(1)}) \mid n_0 > . \tag{2.11}$$

By left multiplying with the bra $< n_0 |$ we obtain:

$$\langle n_0 | H^{(0)} | n_1 \rangle - \langle n_0 | E_n^{(0)} | n_1 \rangle = \langle n_0 | E_n^{(1)} | n_0 \rangle - \langle n_0 | H^{(1)} | n_0 \rangle. \quad (2.12)$$

Taking into account eq. (2.3) and (2.10) we see that the left member of the equation (2.12) equals zero:

$$\langle n_0 | H^{(0)} | n_1 \rangle = \langle n_0 | E_1^{(0)} | n_1 \rangle = E_1^{(0)} \langle n_0 | n_1 \rangle = 0. \quad (2.13)$$

Thus, from the right member of eq. (2.12) we obtain the first order corrections of the eigenvalues:

$$E_n^{(1)} = \langle n_0 | H^{(1)} | n_0 \rangle. \quad (2.14)$$

For obtaining the first order corrections to the eigenfunction $| n_1 >$, we express it as a linear combination of the zero order eigenfunctions $| k_0 \rangle$:

$$| n_1 >= \sum_k c_k | k_0 >= \sum_k \langle n_1 | k_0 \rangle | k_0 \rangle. \quad (2.15)$$

By left multiplying eq. (2.11) with the ket $< k_0 |$ we may write:

$$\langle k_0 | H^0 - E_n^0 | n_1 \rangle = \langle k_0 | E_n^1 - H_\varepsilon^1 | n_0 \rangle. \quad (2.16)$$

The left member of this equation may be written as:

$$\langle k_0 | H^0 - E_n^0 | n_1 \rangle = \langle n_1 | H^0 - E_n^0 | k_0 \rangle = \langle n_1 | E_k^0 | k_0 \rangle - \langle n_1 | E_n^0 | k_0 \rangle =$$

$$= (E_k^0 - E_n^0) \langle n_1 | k_0 \rangle. \quad (2.17)$$

Taking into account that, according to eq. (2.10), $\langle k_0 | E_n^1 | n_0 \rangle = = E_n^1 \langle k_0 | n_0 \rangle = 0,$ from eq. (2.16) we get:

$$\langle n_1 | k_0 \rangle = \frac{\langle k_0 | H^1 | n_0 \rangle}{E_n^0 - E_k^0}. \quad (2.18)$$

By plugging in this expression into eq. (2.15) we finally obtain the eigenfunction's correction in the first order of the perturbations theory:

$$| n_1 >= \sum_{k \neq n} \frac{\langle k_0 | H^1 | n_0 \rangle}{E_n^0 - E_k^0} | k_0 >= \sum_{k \neq n} \frac{H_{kn}^{(1)}}{E_n^{(0)} - E_k^{(0)}} | k_0 > \quad (2.19)$$

where we denoted with $H_{kn}^{(1)} = \langle k_0 | H^1 | n_0 \rangle$ the matrix element of the transition from the *k* level to the *n* level.

Using a similar (but more extended) procedure one may find the second correction to the eigenvalue, and so on:

$$E_n^{(2)} = \left\langle n_0 \mid H^{(2)} \mid n_0 \right\rangle + \sum_{k \neq n} \frac{H_{nk}^{(1)} H_{kn}^{(1)}}{E_n^{(0)} - E_k^{(0)}}. \tag{2.20}$$

In QED, the main difficulty for estimating the corrections to the energies and wave functions is to calculate the sum over the complete set intermediate energies that appear in the expression (2.20).

A very powerful method for overcoming the difficulties associated with these calculations is to replace this sum with the Green function [13], defined by the equation:

$$(H^{(0)} - E_k^{(0)}) G_0(\vec{r}_2, \vec{r}_1; \Omega) = \delta(\vec{r}_2 - \vec{r}_1) \tag{2.21}$$

so that:

$$G_0(\vec{r}_2, \vec{r}_1; \Omega) = \sum_{k \neq n} \frac{\left\langle k_0(\vec{r}_2) \mid n_0(\vec{r}_1) \right\rangle}{E_n^{(0)} - \Omega}. \tag{2.23}$$

The Green function is specific to the system's Hamiltonian and generally it also may be difficult to calculate. However, it is already known for some particular situations, as the central field systems, characterized by a Coulombian attractive force, and could be used in similar economic systems.

3. The Coulombian form of the bond

It is obvious that the long term stability of an economic unit is provided by a certain "attraction force" that the unit operates on each employee. If one would define a "distance" r_n of an employee *n* from the core of the economic unit, it would be reasonable to consider that the bonding energy derived from this attraction force is inverse proportional with this distance, as in the Coulombian case in physics. The most central employees feel the strongest attraction force and have the higher absolute value potential energy, while the most peripheral employees feel the weakest one and have the smallest absolute value potential energy. Thus we may write the potential energy derived from the attraction force that the economic unit exercises on the employee *n* as:

$$E_n = -K \frac{Z_{eff}}{r_n} z_n \tag{3.1}$$

where Z_{eff} is the overall value of the enterprise and z_n is the value of the employee *n*. The sign is used to suggest that the force is an attractive one, so that the employees find themselves in a potential well, with negative quantized energy levels, just as the electrons in an atom.

Considering the normal case that the remuneration of an employee is equal to its value for the economic unit, we may also write:

$$E_n = -K \frac{Z_{eff}}{r_n} | \psi_n(\mathbf{x}) |^2 \ . \tag{3.2}$$

This is exactly the Coulombian form of the bonding energy of a single electron in an atom, suggesting that, for describing some economic processes, one may use the Coulombian Green function given by Schwinger [12]:

$$G_0(\vec{p}_1, \vec{p}_2; \Omega) =$$

$$= \frac{m}{2\pi^2} X^3 \left(\frac{ie^{i\pi\tau}}{2\sin\pi\tau} \right) \int_1^{(0+)} d\rho \, \rho^{-\tau} \frac{d}{d\rho} \left\{ \frac{1-\rho^2}{\rho} \frac{1}{\left[X^2(\vec{p}_1 - \vec{p}_2)^2 + (p_1^2 + X^2)(p_2^2 + X^2) \frac{(1-\rho)^2}{4\rho} \right]^2} \right\}.$$

4. Matrix elements for atomic processes in the second order of the perturbation theory and their interpretation for economic systems

Using the Green function method, in the second order of the perturbation theory, and the QED framework, the matrix elements for the 1s, 2s and 2p atomic processes has been recently calculated [13-15]. Also, *via* the optical theorem[1], analytical formulae for the total cross-sections for the photo effect and pair production with the electron bounded in the atom could be obtained, with a very good accuracy compared with other methods (as the *ab initio* calculations results presented in literature [16,17]).

[1] The optical theorem: The total cross section for the photoeffect is proportional with the imaginary part of the elastic forward scattering amplitude [6].

Such formulae involve several physical parameters that may hardly be associated with the economic theory, so that we should only present the main steps for obtaining them, and interpret the qualitative results.

Thus, the Kramers-Heisenberg-Weller matrix elements for elastic processes in the second order of the perturbations theory are:

$$M_{if}(\Omega_1) = -m \lim_{\varepsilon \to 0} \sum_n \frac{< f \mid e^{-i\vec{k}_2 \cdot \vec{r}_2}(\vec{\alpha} \cdot \vec{s}_2) \mid n >< n \mid e^{i\vec{k}_1 \cdot \vec{r}_1}(\vec{\alpha} \cdot \vec{s}_1) \mid i >}{E_n - (\omega_1 + \gamma m + i\varepsilon)} \qquad (4.1)$$

where the most important parameters are: ω_1 is the energy of the incoming perturbation (photon), $\vec{k}_j = \omega_j \vec{v}_j$ and $\vec{s}_j$ are the momentum and the polarization, $\mid i >$ and $\mid f >$ are the Dirac spinors (wavefunctions of the bond electron), m is its mass and E is its energy.

As we may see, this formula implies the summing over the complete set of intermediate states charactrized by the eigenfunctions $\mid n >$ for both positive and negative energies, which may be replaced by the Coulombian Green function:

$$G(\vec{r}_2 \cdot \vec{r}_1; \Omega) = \sum_n \frac{\mid n >< n \mid}{E_n - \Omega} \qquad (4.2)$$

for the Dirac equation:

$$G(\vec{r}_2 \cdot \vec{r}_1; \Omega) =$$

$$= \frac{1}{2m}\left(i\vec{\alpha} \cdot \nabla_2 - \beta m - \frac{\alpha Z}{r_2} - \Omega \right)\left[I + \frac{1}{2\Omega}\vec{\alpha}(\vec{P}_2 + \vec{P}_1) \right] G_0(\vec{r}_2 \cdot \vec{r}_1; \Omega) \qquad (4.3)$$

where $G_0(\vec{r}_2 \cdot \vec{r}_1; \Omega)$ is the Green function for the Schrödinger type equation:

$$\left(-\frac{1}{2m}\nabla_2 - \frac{\alpha Z \Omega}{m}\frac{1}{r_2} + \frac{m^2 - \Omega^2}{2m} \right) G_0(\vec{r}_2 \cdot \vec{r}_1; \Omega) = -\delta(\vec{r}_2 - \vec{r}_1). \qquad (4.4)$$

Using this procedure, the matrix element may be expressed in terms of the Dirac spinors $u_\mu(\vec{p} - \vec{k})$. Considering the finite speed of the perturbations (*i.e.* the retardation), it is more convenient to use the momentum representation of the equations, after a Fourier transform. The analytical expression of the Dirac spinor is specific to a certain Hamiltonian and eigenfunction. For example, for an electron in the ground state (*K* shell), in

the Sommerfeld-Maue approximation (spin corrections neglecting), the Dirac spinor was given by Boyer [18]:

$$u_{\mu}(\vec{p}-\vec{k})=\left[a(\vec{p}-\vec{k})+\frac{\vec{\alpha}(\vec{p}-\vec{k})}{2m}b(\vec{p}-\vec{k})\right]\chi_{\mu}:\ \chi^{+}_{\frac{1}{2}}=(1000),$$

$$\chi^{+}_{-\frac{1}{2}}=(0100). \tag{4.5}$$

With these elements, the transition matrix element for elastic scattering may be expressed in a closed form by neglecting the higher order terms and using only those corresponding to the second order perturbation theory.

For the *K* shell electrons, the analytical form of the elastic scattering amplitudes have been recently calculated [14]. They imply some higher transcendental functions of Appell type $F_1(a-\tau;a,a;a+1-\tau;x_1,x_2)$, which are no more computational challenging and offer a very good agreement (within some percent) with other experimental and theoretical results [16,17]:

$$M^{NR}_{GC}=M_{GC}(\omega,\theta)(\vec{s}_1\vec{s}_2)+N_{GC}(\omega,\theta)(\vec{s}_1\vec{v}_2)(\vec{s}_2\vec{v}_1) \tag{4.6}$$

$$M_{GC}(\omega,\theta)=[\vartheta-P_{GC}(\Omega_1,\theta)-P_{GC}(\Omega_2,\theta)] \tag{4.7}$$

$$N_{GC}(\omega,\theta)=-[Q_{GC}(\Omega_1,\theta)+Q_{GC}(\Omega_2,\theta)] \tag{4.8}$$

$$P_{nr}(\Omega_1)=2^3(\alpha Z)^8\frac{m^4}{\omega^4}\left(\frac{\omega}{\omega_{th}}-1\right)^{\frac{3}{2}}\frac{F_1(2-\tau_1^{nr};2,2;3-\tau_1^{nr};x_1^{nr};x_2^{nr})}{2-\tau_1^{nr}}ie^{4ix_0^{nr}} \tag{4.9}$$

$$Q_{nr}(\Omega_1)=$$

$$=-2^5(\alpha Z)^{10}\frac{m^4}{\omega^4}\left(\frac{\omega}{\omega_{th}}-1\right)^{\frac{5}{2}}\frac{F_1(3-\tau_1^{nr};3,3;4-\tau_1^{nr};x_1^{nr},x_2^{nr})}{3-\tau_1^{nr}}ie^{6ix_0^{nr}} \tag{4.10}$$

$$\vartheta=\left[1+\frac{1}{\alpha^2Z^2}\left(\frac{\omega}{m}\right)^2\sin^2\frac{\theta}{2}\right]^{-2}. \tag{4.11}$$

In the case of the 2*s* and 2*p* subshells, the analytical expressions were also obtained [15], but they are more complicated and shall not be exposed here.

The most important result for our study is the total photo effect cross section, which describes the probability of removing and electron from the atom due to the external perturbation. Thus, by using the optical theorem:

$$\sigma^{PH} = \frac{4\pi}{\alpha}\frac{m}{\omega}r_0^2 \mid \mathrm{Im}M(\omega,\theta=0) \mid = \frac{4\pi}{\alpha}\frac{m}{\omega}r_0^2 \mid \mathrm{Im}P_{nr}(\Omega_1,\theta=0) \mid \quad (4.12)$$

the total photoeffect cross section for the 1s shell is:

$$\sigma_{1s}^{PH} = \frac{32}{3}\pi^2 r_0^2 E_0 m^2 \alpha^5 Z^6 \frac{E_0+\omega}{\omega^4}\frac{e^{-|\tau_1^{nr}|[\pi=\chi_{nr}(\omega)]}}{1-e^{-2\pi|\tau_1^{nr}|}} \quad (4.13)$$

while for the 2s subshell the total photoeffect cross section it is:

$$\sigma_{2s}^{PH} = \frac{2}{3}r_0^2\pi^2\alpha^5 Z^6 \frac{m^2}{\omega^2}\frac{(\mid X_1 \mid^2 +\alpha^2 Z^2\Omega_1^2)}{\omega^2}\frac{\Omega_1}{\omega}\frac{e^{-|\tau_1|[\pi+\chi_1(\omega)]}}{1-e^{-2\pi|\tau_1|}}\times$$

$$\times\left[1-\frac{\alpha^4 Z^4}{20}\frac{\mid X \mid^2}{\omega^2}-\frac{4}{5}\alpha^2 Z^2\frac{\omega_{th}^2}{\omega^2}\right]. \quad (4.14)$$

As an example, the summed photoeffect cross-sections given by these formulae for the lead 1s and 2s electrons as a function of the incoming photon energy are illustrated in figure 1.

5. Conclusions

Some conclusions may be drawn from these formulae, and they already have some correspondence with the economic domain.

Thus, by inspecting the scattering amplitudes expressions, one may prove that they do have an imaginary part only if the incoming perturbation's energy is higher than a certain threshold, which is the electron's binding energy. As the photoeffect cross section is proportional with the imaginary part of the amplitude, (according to eq. (4.12)), it follows that no eviction may appear for a perturbation below this threshold.

This is a predictable result, meaning that the removal of an employee by an external perturbation may only occur if the perturbation is higher than the affinity of that person to the current institution. So, in figure 1 one may see that no effect appears for a certain level of the electron if the incoming photon energy is below an energy threshold. For the most important cases of inner (1s and 2s) electrons, the incoming photon energy must exceed approx. 100 keV and respectively 24 keV. Thus, no inner electron is removed if the perturbation's energy is lower than the 2s

threshold, where the channel for 2s electrons' eviction opens. By further increasing the perturbation's energy, a new channel is opened at the 1s threshold and these mostly bond electrons may also be evicted. For atomic systems with more electrons, the energy thresholds are as many as the binding energies. Of course, the peripheral electrons are the most likely to be removed, even at lower perturbations, while the inner ones need a much higher perturbation.

On the other hand, an intriguing phenomenon may be noticed according to the formulae (4.13)-(4.14) and figure 1. Above the threshold, the total cross section for the photoeffect strongly *decreases* (almost exponentially) with the incoming photon energy. So, how could it be possible for an economic unit that a higher external action to be less likely to remove a certain electron, than a lower one? After all, in economic terms, this action may be measured in the remuneration and position that another economic unit offers to a certain employee of the current one. It is normal that this offer must exceed the actual level, so that the existence of the thresholds is obvious. But the perturbations theory predicts that if the offer increases, the likelihood that the removal of that particular employee to appear decreases.

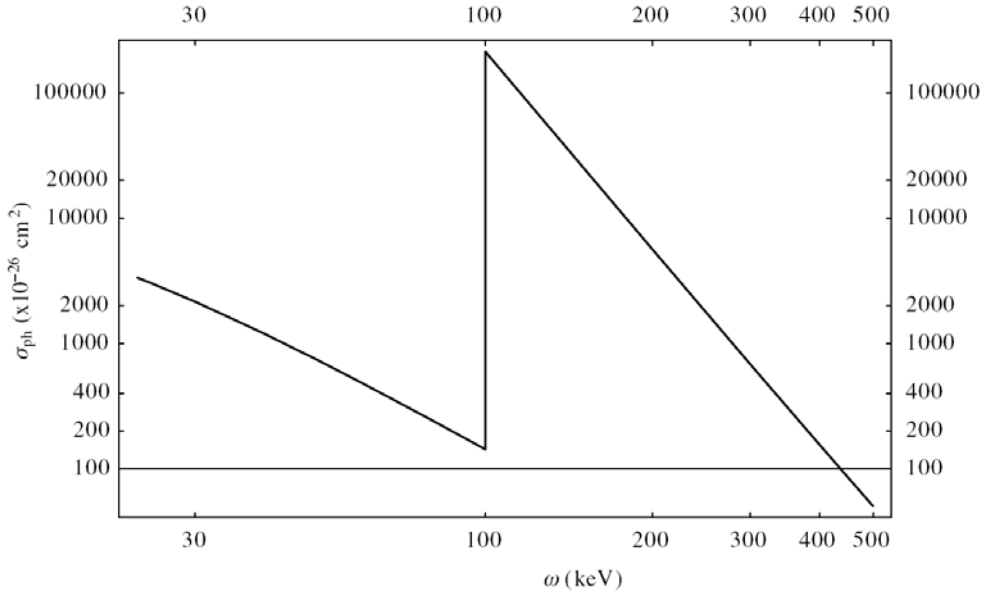

Figure 1. The summed photoeffect cross-sections for the lead 1s and 2s electrons as a function of the incoming photon energy.

In our opinion, this phenomenon must be interpreted in a statistical way. In QED, when the removal of the electron is achieved, the incoming

perturbation (photon) ceases (is absorbed). If it does not occur, the perturbation is applied to another one, maybe on another level or even another atom, and so on, till the absorption does appear. In economic terms, it may be considered that a higher offer is aimed to a higher level, so that *an employee on a lower level in an economic unit is not very often expected to correspond to a higher offer*. The external action is intended to seek the removal of an employee from an as much as possible high level in a statistical collective of economic units, and is rarely "absorbed" by a lower level employee. In other words, a certain external offer is more probably made for the right person, and the probability of making an offer higher than the real level of a person decreases exponentially above the threshold, just as the perturbations theory in QED predicts.

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ADJUSTMENT IN EXCHANGE RATE, INTEREST RATE, AND PRICE LEVEL BY ECONOMIC FORCES

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Abstract. *We model the exchange rate of the currency of a relatively small country vis-à-vis to euro. To construct a complete model for the financial system, the dynamics of interest rate and average price level are modeled too. We show that the exchange rate changes due to imbalances in that part of the balance of payments of the home country, charged in Euros, if the central bank does not sterilize these impulses. The adjustment in the exchange rate, the interest rate, and average price level may be monotonous or oscillating, and the equilibrium may be stable or not. In our model, overshooting takes place in stable cases as compared with Dornbush's (1976) unstable equilibrium. The possible equilibrium exchange rate is shown to be conditional on investors' expectations of its future value. (JEL F31, F32, G15)*

Keywords: *Exchange rate, interest rate, price level, nonlinear dynamics.*

1. Introduction

Flood and Taylor (1996) classify the key theories of exchange rate movements as: 1) the Purchasing Power Parity (PPP) model; 2) the flexible-price monetary model; 3) the sticky price overshooting monetary model; 4) the portfolio balance model, and 5) the equilibrium model. According to the authors, simple macro fundamentals − relative inflations and interest rates − have poor explanatory power in exchange rate movements even over one-year horizon. Five-, ten-, and twenty-year averages, on the other hand, show a strong proportionality between exchange rate depreciation and movements in these fundamentals. A simple macro fundamentals based model thus outperforms the random-walk model at

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horizons of five years or longer. "…there are speculative forces at work in the foreign exchange market that are not reflected in the menu of macro-economic fundamentals..." (ibid. p. 285-6) "...exchange rate fundamentals change very slowly … while exchange rate time series show huge variation".' (ibid. p. 287).

Meese & Rogoff (1983a) report that none of their tested macro-based exchange rate models outperforms the random-walk model. In (1983b), however, Meese & Rogoff and Koedijk & Schotman (1990) found models that outperform the random-walk model at time horizons beyond one year. Berben & de Jong (1999) report mean-reverting behavior of exchange rates toward the PPP equations and that the PPP theory does not explain the short-term movements. In Cappiello & De Santis (2005), the Uncovered Equity Return Parity theory beats the random walk model at two – and three-month forecasts in EUR/USD rate, but their specifications for the British pound did not beat the random walk model.

The role of expectations in modeling exchange rates has been studied e.g. by Chiarella et al. (2009) and Gourinchas & Tornell (2002). In Chiarella et al. the driving macro factor in exchange rates is the interest rate differential and the market microstructure element is described by the expectations of portfolio managers. Gouringas & Tornell claim that exchange rates are determined by two effects: an interest rate effect and a learning effect. Excess returns in currency markets result if agents misperceive interest rate shocks to be more transitory than they are.

We can summarize this review as follows. The exchange rate models have been concentrated on the international trade of goods by price competition (the PPP theory), on investors' speculative investments (the Interest Rate Parity (IRP) theory and the portfolio balance model), on macro-level money market behavior (the flexible and sticky price monetary models), or on general equilibrium in a two country model (the equilibrium model). The evidence supports the PPP theory in the long-term, but modeling the short-term fluctuations has been less successful. According to theoretical completeness and empirical success, none of the mentioned models alone fulfills the criteria for a complete theory of exchange rate movements. For that we need a theory that explains the short – and the long-term movements, where the international trade of goods and assets is present together with central bank's operations.

Here we introduce such model. Even though we operate with macro-level quantities, the proposed model is consistent with rational behavior of economic agents: physical investments depend on real GDP and interest rate, international trade of goods and assets depends on price and yield competition, and the demand of liquid funds depends on domestic and international trade. The modeled "prices" − exchange rate, interest rate, and average price level − are assumed to adjust according to excess demand in the corresponding market. We define the "economic forces" acting upon the three adjusting quantities which terminology has been used e.g. by Flood & Taylor (1996, p. 286) and Park (1997, p. 478). These forces contain parameters that allow the central bank to steer the process. The equilibrium values of the adjusting quantities define the steady-state of the model − the "zero-force" situation. We define inertial factors for the adjusting quantities and study the effect of inertia for the adjustment process.

The study is organized as follows. The current and the financial account of the home country are modeled in sections 2, 3. In sections 4, 5 is introduced a model for the exchange rate. Section 6 presents a model for the interest rate, and in section 7 exchange and interest rate are analyzed together. In section 8 is a model for average price level and in section 9 the complete model. Section 10 is a summary.

2. Modeling Current Account

We study the exchange rate of the currency of a small country vis-à-vis to euro. For simplicity, the home country is assumed to be Sweden but the modeling applies to any country with an own currency. The willingness to exchange euros to Swedish kronas due to the international trade of goods depends on the revenues of Swedish exporting firms in euros that have costs in kronas. Similarly, the willingness to exchange Swedish kronas to euros due to the international trade of goods depends on the revenues of Swedish importing firms in kronas that pay to their suppliers in euros. The part of the current account of Sweden, expressed in euros, is denoted as $R = X - M$, where $X(EUR/y)$ is export revenues[1] and $M(EUR/y)$ import costs of Swedish firms at time unit y. Firms' net willingness to change kronas to euros due to international trade then depends on R.

[1] Measurement units are in braces after the quantities; see de Jong (1967). Unit y can be any time unit.

We denote the price of Swedish export good i by $p_i(SEK/kg)$ and the euro price of the corresponding foreign good by $p_{fi}(EUR/kg)$. The international price competitiveness of Sweden is measured by H_R:

$$H_R = \sum_{i=1}^{n} w_i[S(t)p_{fi} - p_i] = S(t)\sum_{i=1}^{n} w_1 p_{fi} - \sum_{i=1}^{n} w_i p_i(t) = S(t)\overline{p}_f - \overline{p}(t), \quad (1)$$

where $0 \le w_i \le 1, \sum_{i=1}^{n} w_i = 1,$ are the weights of the goods in the measure, n the number of possible export goods in Sweden, $\overline{p}_f, \overline{p}$ weighted averages of prices abroad and in Sweden, and $S(SEK/EUR)$ the exchange rate of the currencies; $S, \overline{p}$ are set as functions of time t because later we model their dynamics. The greater H_R is, the better the price competitiveness of Sweden.

Our literature review shows that the short-term changes in exchange rates are caused by financial investments, and in the long-term exchange rates adjust so that the PPP equations hold. This is understandable because PPP equations express equalities between purchasing powers of currencies. Suppose the law of one price holds for all n goods between Sweden and the euro area. Then:

$$H_R = 0 \Leftrightarrow S\sum_{i=1}^{n} w_i p_{fi} = \sum_{i=1}^{n} w_i p_i \Leftrightarrow S\overline{p}_f = \overline{p} \Leftrightarrow \frac{1}{S\overline{p}_f} = \frac{1}{\overline{p}},$$

where $\overline{p}_f, \overline{p}$ are as in (1). The last form of the equation shows equality in purchasing powers of the currencies in units kg/SEK. If this does not hold, people begin to exchange the less powerful currency to the more powerful one until exchange rate balances the purchasing powers. However, because goods' prices are rigid, other explanations are needed for short-term movements in exchange rates.

Because the quality of goods is difficult to measure, the international trade of goods and services is assumed to be determined according to price competitiveness. We can thus write:

$$X = f(H_R),\ f'(H_R) > 0,\ f(0) = 0;\ M = g(H_R),\ g'(H_R) < 0,\ g(0) = 0.$$

The model for R becomes then:

$$R(H_R) = f(H_R) - g(H_R),\ R'(H_R) = f'(H_R) - g'(H_R) > 0,\ R(0) = 0. \quad (2)$$

From (2) we get: $\partial R/\partial \overline{p}_f > 0,\ \partial R/\partial \overline{p} < 0,$ and $\partial R/\partial S > 0.$ Devaluation of Swedish krona vis-à-vis to euro thus has a positive effect on the price competitiveness and also on the current account of Sweden.

3. Modeling Financial Account

International investments are assumed to be made according to the highest expected yield, and we study directly net investment flows. In continuous time, the uncovered interest rate parity equation is:

$$E_t[S(t_1)] = S(t)e^{\int_t^{t_1}(r(s)-r_f(s))ds}, \ t_1 > t,$$

see the Appendix. By r with unit $1/y$ is denoted the Swedish interest rate, by r_f with unit $1/y$ the interest rate of euro, and $E_t[S(t_1)]$ is investors' expectation at time moment t of the spot rate at time t_1. The net investment flow of euros to Sweden at time moment *t* then depends on quantity H_F :

$$H_F = S(t)e^{\int_t^{t_1}(r(s)-r_f(s))ds} - E_t[S(t_1)]. \qquad (3)$$

If $H_F > 0,$ investors on the average consider that investing in Sweden is more profitable than in the euro area and vice versa, see the Appendix. Thus H_F measures the international yield competitiveness of Swedish assets; the greater H_F is, the better the yield competitiveness of Swedish assets.

We denote that part of the financial account of Sweden, charged in euros, by $B(EUR/y),$ at time *t*:

$$B = h(H_F), \ h'(H_F) > 0, \ h(0) = 0.$$

If $B > 0,$ a positive net investment flow of euros takes place to Sweden and vice versa. By taking account (3) the following results are obtained from (4): $\partial B/\partial S > 0, \partial B/\partial r > 0, \partial B/\partial r_f < 0,$ and $\partial B/\partial E_t[S(t_1)] < 0.$ The devaluation of Swedish krona vis-à-vis to euro and an increase in Swedish interest rate thus have a positive, and an increase in the interest rate of euro and an expectation of the future devaluation of Swedish krona have a negative effect on the financial account of Sweden.

4. Modeling Exchange Rate Dynamics

Daily changes in exchange rates occur due to people's daily willingness to exchange currencies. We do not know, however, whether these daily demands and supplies are caused by transactions in goods or

asset markets. Due to this, both these reasons for exchanging currencies must be included in a theory attempted as a complete description for the determination of exchange rates. The balance of payments contains both these items, however. The part of the balance of payments of Sweden, charged in euros $N(EUR/y)$, can be formulated roughly by adding the corresponding current and financial accounts:

$$N = X - M + B = f(H_R) - g(H_R) + h(H_F). \quad (5)$$

Now $S'(t)$ with unit $SEK/(EUR \times y)$ measures the instantaneous flow of the exchange rate; if $S'(t) > 0$. Swedish krona is devaluing against euro and vice versa. The equation of motion for the exchange rate is:

$$S'(t) = \Phi_s(F_s),\ F_s = A_1(t) - (1-a)N(t),\ \Phi'(F_s) > 0,\ \Phi_s(0) = 0, \quad (6)$$

where A_1 with unit EUR/y is Swedish central bank's net buying of euros by kronas at time unit *y*; if $A_1 > 0$, Swedish central bank buys EUR with SEK and vice versa; $0 < a < 1$ is the share of the balance of payments of Sweden expressed in euros that is left on currency accounts in banks and is not exchanged to kronas when N is positive (from kronas to euros when N is negative). For simplicity, a is assumed to be a constant that reflects the payment routines of firms. According to Eq. (6), $S'(t) > 0$ if $F_s = A_1 - (1-a)N > 0$, and vice versa. We name F_s as the "force" acting upon the exchange rate S. Eq. (6) gives a clear policy rule for the central bank if it aims to keep the exchange rate fixed: $S'(t) = 0$ if $F_s = 0 \Leftrightarrow A_1 = (1-a)N$, Thus if $N > 0$, the central bank must buy EUR by SEK for SEK not to revalue, and vice versa.

Because of the general functional forms in Eq. (6), we do not try to solve the equation but only study its economic implications. From (6) we get $\partial S'(t)/\partial S < 0$, and if this relation is strong enough so that $S'(t)$ changes its sign with large changes in $S(t)$, the process is stable. Results $\partial S'(t)/\partial i < 0, i = r, \overline{p}_f$, and $\partial S'(t)/\partial j > 0,\ j = r_f, \overline{p}, E_t[S(t_1)], A_1$, show that increases in domestic prices increase the speed of devaluation of krona etc. Investors' expectations of future devaluation of Swedish krona vis-à-vis to euro increase its current speed of devaluation via international investments, and if Swedish central bank increases its buying of euros by kronas, this increases the speed of devaluation of krona.

5. Equilibrium Exchange Rate

The equilibrium exchange rate S^* is obtained from Eq. (6) by setting $F_s = 0 \Leftrightarrow S'(t) = 0.$ This gives:

$$A_1(t) = (1-a)[R(H_R) + h(H_F)]. \quad (7)$$

From (7) we get by implicit differentiation: $\partial S^* / \partial i < 0, i = r, \overline{p}_f,$ and $\partial S^* / \partial j > 0,\ j = r_f, \overline{p}, A_1, E_t[S(t_1)].$ These results support the common assumptions of factors affecting exchange rates, and $\partial S^* / \partial E_t[S(t_1)] > 0$ shows that expectations fulfill themselves, that is, expected future devaluation has an immediate devaluing effect on krona. To get a preliminary formula for the equilibrium exchange rate, we assume all behavioral functions in (6) linear and passing through the origin. Eq. (6) takes then the form:

$$m_s S'(t) =$$

$$= A_1(t) - (1-a)\left[\alpha(S(t)\overline{p}_f - \overline{p}) + \beta\left(S(t)e^{\int_t^{t_1}(r(s)-r_f(s))ds} - E_t[S(t_1)]\right)\right], \quad (8)$$

where $R(H_R) = \alpha H_R, h(H_F) = \beta H_F$ and $\alpha, \beta > 0$ are constants with units $(kg \times EUR)/(SEK \times y)$ and $EUR^2 / SEK \times y),$ respectively. Constant $m_s > 0$ with unit EUR^2 / SEK has the same role as inertial mass in Newtonian mechanics, $m_s = F_s / S'(t), F_s = A_1 - (1-a)N.$ The greater m_s is, the less sensitive $S(t)$ is to changes in F_S. Parameters α, β measure consumers' and investors' sensitivity to $H_R, H_F,$ respectively.

The equilibrium exchange rate S^* is obtained from (8) as follows:

$$S'(t) = 0 \Leftrightarrow S^* = \frac{A_1(t) + (1-a)(\alpha\overline{p} + \beta E_t[S(t_1)])}{(1-a)\left[\alpha\overline{p}_f + \beta e^{\int_t^{t_1}(r(s)-r_f(s))ds}\right]},$$

Because S^* is a time-dependent random variable, this explains the vulnerability of exchange rates as compared with goods' prices. Eq. (8) can be presented in Error-Correction form, too, as:

$$S'(t) = -z[S(t) - S^*],\ z = \frac{(1-a)}{m_s}\left(\alpha\overline{p}_f + \beta e^{\int_t^{t_1}(r(s)-r_f(s))ds}\right) > 0. \quad (9)$$

where z is the Error-Correction "coefficient". According to (9), $S'(t) > 0$ if $S(t) < S^*$, and vice versa.

6. Dynamics of Interest Rate

In section 5 the exchange adjustment was monotonous, but we have evidence that exchange rates may adjust in an overshooting manner too. To model this kind of behavior, we assume the time unit short enough for the price level to stay fixed (i.e. less than a month). In short-term, the adjusting variables in money and currency markets are the exchange and the interest rates while goods' prices are more rigid.

Domestic interest rate is assumed to adjust in the money market according to the excess demand of Swedish kronas. A stable demand function for Swedish kronas − independent of international trade − is assumed and called the "domestic" component of the demand. This depends on the Swedish nominal GDP (the transaction motive) denoted by $Y(t) = \bar{p}(t)Q(SEK/y,$ where $Q(kg/y)$ is the real GDP valued by the average price level $\bar{p}(SEK/kg)$. For simplicity, Q is assumed constant. The speculative component of domestic demand of Swedish kronas negatively depends on interest rate due to the alternative cost for liquid wealth. The international demand component of Swedish kronas depends on the surplus in the balance of payments of Sweden of which N is a part. The total balance of payments of Sweden is denoted as $N_T = N + N_R$ where N_R is the rest of the balance of payments charged in other currencies than euro (N_R is though expressed in euros with unit EUR/y). For simplicity, N_R is assumed constant.

The demand of Swedish kronas M_D with unit SEK at time moment t is then:

$$M_D(t) = \left[L\big(Y(t), r(t)\big) + (1-a)S(t)[N(t) + N_R]\right]\Delta t,\ \frac{\partial L}{\partial Y} > 0,\ \frac{\partial L}{\partial r} < 0,$$

where $L(Y(t), r(t))$ is the domestic component of the demand, $\Delta t = y$ the length of the time unit that transforms the measurement units to those required, and constant $0 < \alpha < 1$ was defined earlier. The amount of Swedish kronas circulating in the economy at moment t, $M_s(t)$ with unit SEK, is then:

$$M_s(t) = M_s(t-y) + A_2(t) + S(t)A_1(t)\Delta t,$$

where $M_s(t-y)$ is the money in circulation at time $t-y$, and $A_2(SEK)$ the extra supply of Swedish kronas by Swedish Central bank during time unit y. If $A_1, A_2 > 0$, Swedish central bank increases its supply of Swedish kronas in the market, and vice versa. The excess demand of kronas at time t is then:

$$M_D - M_S =$$

$$= [L(Y(t), r(t)) + ((1-a)[N(t) + N_R] - A_1(t))S(t)]\Delta t - M_S(t-y) - A_2(t).$$

If $N < 0$, people buy euros by kronas more than they do the opposite, and then $(1-\alpha)\, SN\Delta t < 0$, is a part of supply of kronas. However, if $A_1 < 0$, the term $-A_1 S\Delta t > 0$ is a part of the demand of kronas by euros.

The money market in Sweden is dynamized as follows:

$$r'(t) = \Phi_r(F_r), \quad \Phi'_r(F_r) > 0, \quad \Phi_r(0) = 0, \quad F_r = M_D - M_S, \quad (10)$$

where F_R is the "force" acting upon the interest rate. This force contains central bank's policy variables A_1, A_2; setting $A_1 = (1-a)[N + N_R]$, $A_2 = L(Y,r)\,\Delta t - M_S(t-y)$, the central bank can eliminate the force.

By taking account (5) we get from (10): $\partial r'(t)/\partial i > 0, i = Q, \overline{p}_f$, and $\partial r'(t)/\partial j < 0,\ j = A_1, A_2, M_S(t-y), r_f, E_t[S(t_1)]$, while the signs of $\partial r'(t)\partial k, k = r, S, \overline{p}$, are ambiguous. To save space we analyze only the ambiguous results. An increase in $\overline{p}$ may increase or decrease $r'(t)$. The domestic demand component causes a positive effect (increasing $\overline{p}$ raises the need of liquid funds), and the international demand component causes a negative effect (increasing $\overline{p}$ reduces the current account). An increase in r has a negative effect on the domestic demand thus decreasing $r'(t)$, and a positive effect on the international demand. An increase in S improves the balance of payments of Sweden thus negatively affecting $r'(t)$. However, only if $(1-a)[N + N_R] - A_1 > 0$, we can uniquely sign the partial as $\partial r'(t)/\partial S > 0$.

The equilibrium state in the money market, $F_r = 0 \Leftrightarrow r'(t) = 0$, gives:

$$[L(Y(t), r(t)) + (1-a)S(t)[N(t) + N_R] - A_1(t)S(t)]\Delta t + A_2(t) = M_S(t-y). \quad (11)$$

From (11) we can derive results concerning the equilibrium interest rate r^*. All these partials turn out to be of ambiguous sign, however, and so we do not present them.

7. Dynamics of Money and Currency Markets

Due to the general functional forms in Eq. (6) and (10) we study the system by phase diagrams, see the Appendix. From (7) and (11) we get the slopes of curves $S'(t) = 0$ and $r'(t) = 0$ in coordinates (r, S) as:

$$\left.\frac{\partial S^*}{\partial r}\right|_{S'(t)=0} = -\frac{h'(H_F)\dfrac{\partial H_F}{\partial r}}{R'(H_R)\dfrac{\partial H_R}{\partial S} + h'(H_F)\dfrac{\partial H_F}{\partial S}} < 0,$$

$$\left.\frac{\partial r^*}{\partial S}\right|_{r'(t)=0} = \frac{A_1 - (1-a)\left[N + N_R + S\dfrac{\partial N}{\partial S}\right]}{\dfrac{\partial L}{\partial r} + (1-a)S\dfrac{\partial N}{\partial r}}.$$

The attracting or repelling character of the demarcation lines depends on the signs of the partials:

$$\frac{\partial S'(t)}{\partial S} = -\Phi'_S(F_S)(1-a)\left[R'(H_R)\frac{\partial H_R}{\partial S} + h'(H_F)\frac{\partial H_F}{\partial S}\right] < 0,$$

$$\frac{\partial r'(t)}{\partial r} = \Phi'_r(F_r)\left[\frac{\partial L}{\partial r} + (1-a)S\frac{\partial N}{\partial r}\right] = \Delta t.$$

Line $S'(t) = 0$ is thus an attractor in the direction of S, and line $r'(t) = 0$ is an attractor in the direction of r if $\partial L/\partial r + (1-a)\partial N/\partial r < 0$, and vice versa. Now, we get six cases depending on the sign of $\partial r'(t)\partial r$ and whether the slope of curve $r'(t) = 0$ is positive or negative, or steeper than that of curve $S'(t) = 0$ in coordinates (r, S). The non-plausible cases of exactly horizontal and vertical slopes are omitted. If the central bank does not overreact when it tries to stabilize the balance of payments, then $|A_1| \le |(1-a)[N + N_R]|$. Assuming this we see that $\partial r^*/\partial S > 0$ if $N + N_R < 0$ and $\partial N/\partial S, |\partial L/\partial r|$ are small, and $\partial N/\partial r$ is large. However, $\partial r^*/\partial S > 0$ holds also if $N + N_R > 0$ and $|\partial L/\partial r| > (1-a)S\,\partial N/\partial r$.

The system is stable in Figures 1-3 and unstable in Figures 4-6; The adjustment is cyclic in Figures 1, 2 and monotonous in Figure 3 (the initial points are assumed to be on the demarcation lines). Overshooting takes place in Figures 1, 2, but contrary to Dornbush's (1976) and Lyons' (1990) models, here overshooting takes place in stable cases. We thus do not have

to make the strong assumptions of these authors that investors in the market rightly guess the location of the saddle-path and that the investors operate together so that the exchange rate exactly jumps on the saddle-path. Such information requirements question the reliability of these models in explaining real world behavior.

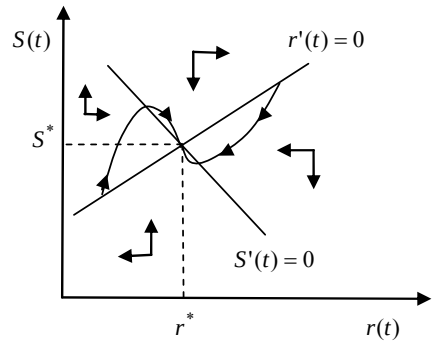

Figure 1.

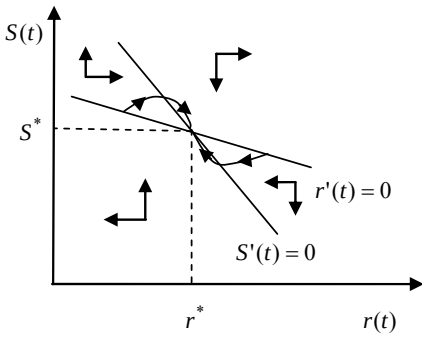

Figure 2.

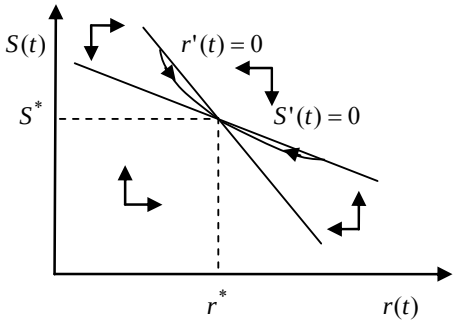

Figure 3.

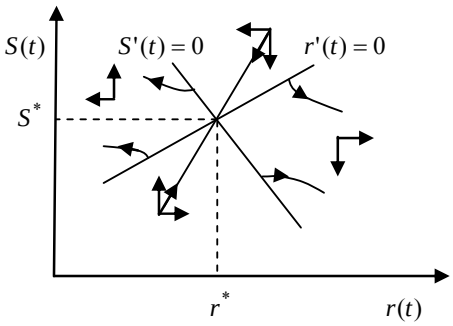

Figure 4.

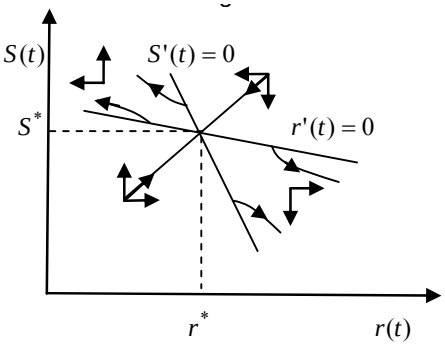

Figure 5.

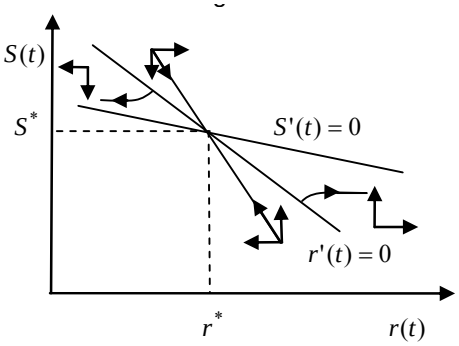

Figure 6.

The proposed model raises also another critical comment concerning the strong form of rational expectations hypothesis in economics. Suppose (6) is the true model for exchange rate behavior. Then none of the agents in the market has enough information to accurately forecast the exchange rate because the model contains unspecified functions. Thus we should not use an exact theory in modeling expectations unless we know that the theory is the true one and all agents are aware of this.

In the model, any of the quantities $A_1, A_2, Q, E_t[S(t_1)]$, $M_S(t-y), r_f, \overline{p}, \overline{p}_f$ may cause an impulse in the system, and S, r either converge into their equilibrium values (Figures 1-3, 7-8), or diverge away from them (Figures 4-6, 9).

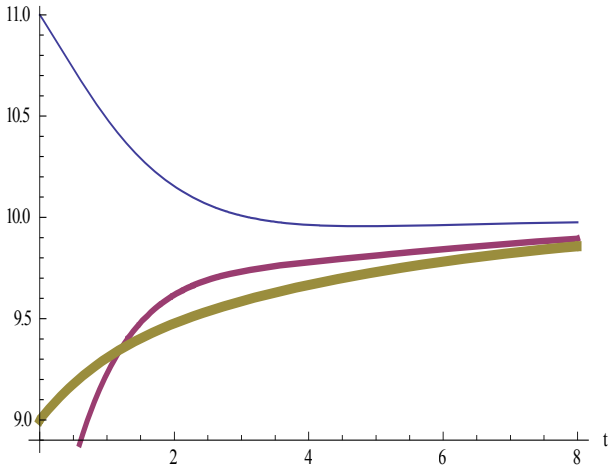

Figure 7.

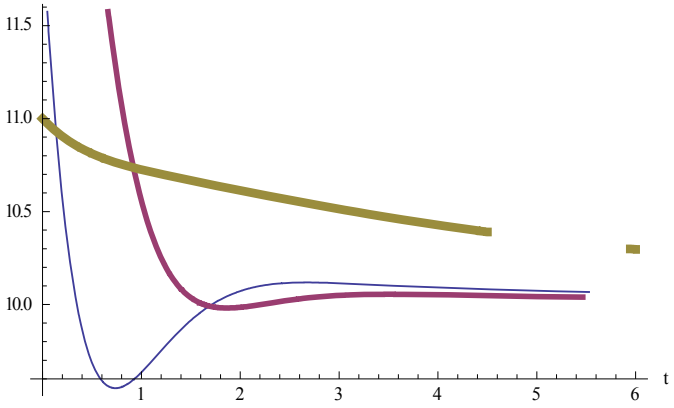

Figure 8.

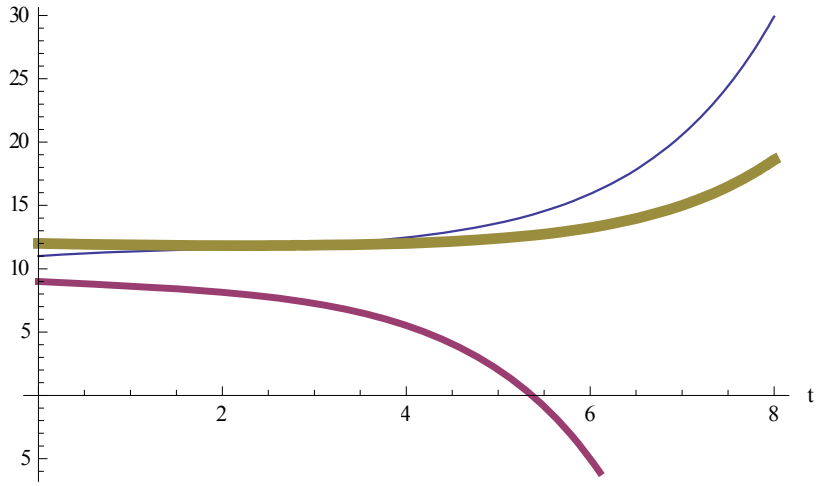

Figure 9.

This critically depends on quantities: $\partial N / \partial S$, $\partial N / \partial r$, and $\partial L / \partial r$. Unstable cases are examples of financial panics. Suppose the domestic interest rate decreases due to some reason. Such nominal reasons could be an expected future devaluation of krona $(\Delta E_t[S(t_1)] > 0)$, or that the central bank increases its supply of kronas $(\Delta A_i > 0, i = 1,2)$. A real reason could be a decrease in Swedish real GDP $(\Delta Q < 0)$. A decrease in r diminishes the financial account of Sweden which decreases the international demand of kronas thus further decreasing r. Decreasing financial account has a devaluing effect on krona, which may stabilize the balance of payments. However, if the devaluation is not strong enough to turn the balance of payments positive, decreasing international demand of kronas further decreases r. The process continues with decreasing r, balance of payments deficit, and the devaluation of krona vis-à-vis to euro. For the same reasons, we may also observe increasing r, surplus in balance of payments and a continuous revaluation of krona if the revaluation does not stabilize the balance of payments.

8. Dynamics of Price Level

To study the adjustment of the whole financial system, we introduce a model for the average price level. We set $\bar{p}$ to adjust according to the excess demand in the goods' market. The domestic demand of goods depends on real consumption $C(Q)$, real investment $I(Q,r)$ and real public

demand G; these all have unit kg/y. The international demand of Swedish goods consists of real exports $S \times X / \overline{p} = S \times f(H_R) / \overline{p}$ with unit kg/y. The supply in the goods' market consists of domestic real GDP $Q(kg/y)$ and real imports $M / \overline{p}_f = g(H_R) / \overline{p}_f$ with unit kg/y. The equation of motion for $\overline{p}$ is then:

$$\overline{p}'(t) = \Phi_{\overline{p}}(F_{\overline{p}}), \; F_{\overline{p}} = C(Q) + l(Q, r(t)) + G + \frac{S(t) f(H_R)}{\overline{p}(t)} - \frac{g(H_R)}{\overline{p}_f} - Q,$$

$$\Phi'_p(F_{\overline{p}}) > 0, \; \Phi_{\overline{p}}(0) = 0. \qquad (12)$$

The excess demand in the goods' market $F_{\overline{p}}$ is the "force acting upon $\overline{p}$". Eq. (12) is the macro-level analogue for the law of demand and supply for a single good in Samuelson (1941). From (12) we get: $\partial \overline{p}'(t) / \partial i > 0$, $i = S, \overline{p}_f, G$, $\partial \overline{p}'(t) / \partial j < 0$, $j = \overline{p}, r$, and $\partial \overline{p}'(t) / \partial Q > 0$ if $C'(Q) + \partial l / \partial Q > 1$, and vice versa. The equilibrium average price level $\overline{p}^*$ is obtained from (12) by setting $F_{\overline{p}} = 0 \Leftrightarrow \overline{p}'(t) = 0$. From the resulting equation we get: $\partial \overline{p}^* / \partial i > 0, i = S, \overline{p}_f, G$; $\partial \overline{p}^* / \partial r < 0$, while $\partial \overline{p}^* / \partial Q$ is of ambiguous sign.

9. Simulations with the Model

In order to study the whole model, we take the first order Taylor series approximation of the system in the neighborhood of the equilibrium point $(S^*, r^*, \overline{p}^*)$. This assumption is supported by Meese & Rose (1991) who report no evidence of nonlinearities in exchange rate models. We introduce three nonnegative inertial factors: $m_s = 1/\Phi'_s(F_s)$ with unit EUR^2 / SEK (already discussed in the context of Eq. (6)), $m_r = 1/\Phi'_r(F_r)$ with unit $SEK \times y^2$, and $m_{\overline{p}} = 1/\Phi'_p(F_{\overline{p}})$ with unit kg^2 / SEK. For example, $m_{\overline{p}}$ measures the sensitivity of $\overline{p}'(t)$ with respect to the force $F_{\overline{p}}$, similarly as mass measures inertia in Newton's equation $F = ma$. This way we can study the role of inertia of the adjusting quantities for the dynamics. Now $F_s, F_r, F_{\overline{p}}$ are functions of $Z^*, Z^* = (S^*, r^*, \overline{p}^*, Z_0)$, where Z_0 is a fixed vector of the exogenous quantities. Because $F_s(Z^*) = F_r(Z^*) = F_{\overline{p}}(Z^*) = 0$, the linearized form of the model takes the form:

$$\begin{pmatrix} m_s S'(t) \\ m_r r'(t) \\ m_{\bar{p}} \bar{p}'(t) \end{pmatrix} = \begin{pmatrix} \frac{\partial F_s}{\partial S}(Z^*) & \frac{\partial F_s}{\partial r}(Z^*) & \frac{\partial F_s}{\partial \bar{p}}(Z^*) \\ \frac{\partial F_r}{\partial S}(Z^*) & \frac{\partial F_r}{\partial r}(Z^*) & \frac{\partial F_r}{\partial \bar{p}}(Z^*) \\ \frac{\partial F_{\bar{p}}}{\partial S}(Z^*) & \frac{\partial F_{\bar{p}}}{\partial r}(Z^*) & \frac{\partial F_{\bar{p}}}{\partial \bar{p}}(Z^*) \end{pmatrix} \begin{pmatrix} S(t) - S^* \\ r(t) - r^* \\ \bar{p}(t) - \bar{p}^* \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{pmatrix}$$

where $\varepsilon_i, i = 1,2,3$ are constants the numerical values of which depend on the degree of nonlinearity of functions $\Phi_i, i = S, r, \bar{p},$ and on the values of the exogenous variables.

For the simulations we set $\varepsilon_i = 0, i = 1,2,3$ and $S^* = r^* = \bar{p}^* = 10.$ Interest rate is thus expressed in per cent, average price level in proper units and $10\,(SEK / EUR)$ is close to the prevailing rate. For $\partial F_s / \partial S$ etc. we set values the signs of which match the results derived, and $m_{\bar{p}}$ is assumed to be greater than m_s, m_r; producers and consumers are thus assumed to be more rigid than investors. The results with certain initial conditions are shown in Figures 7-9; the thinnest curve represents $S(t)$ and the thickest $\bar{p}(t)$. In all cases, $m_s = m_r = 1,\ m_{\bar{p}} = 3,$ and the other parameters are as follows. **Figure 7:** $\partial F_s / \partial S = -1,\ \partial F_s / \partial r = -0.5,\ \partial F_s / \partial \bar{p} = 0.5;$ $\partial F_r / \partial S = 0.5, \partial F_r \partial r = -1,\ \partial F_r / \partial \bar{p} = 0.5;\ \partial F_{\bar{p}} / \partial S = 0.5, \partial F_{\bar{p}} / \partial r = -0.5;$ $\partial F_{\bar{p}} / \partial \bar{p} = -1,$ **Figure 8:** $\partial F_s / \partial S = -2;\ \partial F_S / \partial r = -1,\ \partial F_S / \partial \bar{p} = 0.5,$ $\partial F_r / \partial S = 2,\ \partial F_r / \partial r = -2,\ \partial F_r / \partial \bar{p} = -0.2,\ \partial F_{\bar{p}} / \partial S = -0.3;\ \partial F_{\bar{p}} / \partial r = -0.3,$ $\partial F_{\bar{p}} / \partial \bar{p} = -1,$ **Figure9:** $\partial F_S / \partial S = -1,\ \partial F_S / \partial r = -0.5,\ \partial F_S / \partial \bar{p} = 0.5;$ $\partial F_r / \partial S = 1, \partial F_r / \partial r = 1,\ \partial F_r / \partial \bar{p} = -0.2;\ \partial F_{\bar{p}} / \partial S = 0.5,\ \partial F_{\bar{p}} / \partial r = -0.5,$ $\partial F_{\bar{p}} / \partial \bar{p} = -1.$

In Figure 7, the adjustment is smooth while in Figure 8 the exchange and the interest rate overshoot their equilibrium values. Figure 9 shows an unstable case where the money and the currency market collapse: krona devalues, interest rate decreases, and hyperinflation takes place in goods' market.

10. Conclusions

We modeled the exchange rate of the currency of a small country on the basis of the international competitiveness of the country in terms of relative prices and expected yields in investments. The model produces the

common forecasts how various macro variables affect the exchange rate, it explains the mean-reverting behavior of exchange rates and also their vulnerability: the equilibrium exchange rate was shown to be a random variable that depends on investors' expectations of its future value. In order to model the observed nonlinear behavior of exchange rates, an equation for interest rate was added in the model. By the dynamic model of two equations, overshooting and currency crises were shown to occur in certain cases. Adding an equation for price dynamics in the model, the simultaneous adjustment of the three quantities was shown to be either monotonous or cyclic, and either stable or non-stable.

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Appendix

Let $x(t)$ be kronas to be invested in Sweden and $z(t)$ euros to be invested in a euro country at time *t*. Continuous time interest rates r, r_f in the two countries are defined as growth rates of the investments,

$$\frac{x'(t)}{x(t)} = r(t), \qquad \frac{z'(t)}{z(t)} r_f(t).$$

The left hand sides have unit $1/y(SEK/y$ divided by SEK and EUR/y divided by $EUR)$ and so have the right hand sides. Solving these equations gives:

$$x(t_1) = x(t)e^{\int_t^{t_1} r(s)ds}, \quad z(t_1) = z(t)e^{\int_t^{t_1} r_f(s)ds}, \quad t \le s \le t_1.$$

where $x(t_1)$ are the kronas and $z(t_1)$ the euros to be obtained at time t_1. Let $S(t)$ (SEK/EUR) be the spot rate at time t and $E_t[S(t_1)]$ investors' expectation at time t of the spot rate at time t_1. Investing in Sweden is expected to be more profitable if $E_t[(t_1)]z(t_1) < x(t_1)$ holds with $x(t) = S(t)z(t)$ (equal amounts are invested and more kronas are expected from Sweden). Money is thus flowing into Sweden, if:

$$\frac{x(t_1)}{z(t_1)} > E_t[S(t_1)] \Leftrightarrow \frac{S(t)z(t)e^{\int_t^{t_1} r(s)ds}}{z(t)e^{\int_t^{t_1} r_f(s)ds}} > E_t[S(t_1)] \Leftrightarrow$$

$$\Leftrightarrow S(t)e^{\int_t^{t_1} (r(s)-r_f(s)ds)} - E_t[S(t_1)] > 0.$$

AN ECONOPHYSICS MODEL FOR INVESTMENTS USING THE LAW OF THE ELECTRIC FIELD FLOW (GAUSS' LAW)

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Abstract. *In this paper a new econophysics model of investment processes is proposed and discussed. For this purpose an analogy between the electric field flow and the investment supplying flow with credits for the considered investment is used.*

Keywords: *econophysics, electrical field, Gauss' Law, investment process, investment field.*

1. Introduction

In order to model the economic phenomena and processes, besides the mathematical methods, which led to econometrics, the researchers resorted to models based on the similarity of the economic phenomena and processes with physics laws and processes, which led to the emergence of the new interdisciplinary science, namely econophysics.

The majority of studies and papers published or communicated to econophysics conferences or symposiums present the results of the economic modelling using mostly mathematical statistics methods and statistical physics methods (see for instance [1-14]). As a result, most researchers and analysts refer only to this part of econophysics, based on statistical physics' methods, which can be named **statistical econophysics**.

On the other hand, econophysics implies including in the research resources of other domains of physics, especially from phenomenological physics, as chapters of thermodynamics, electricity, solid state physics, nuclear or optical physics etc. Indeed in the last years many researchers included in their papers some models based on analogies between the economical phenomena or processes and laws or processes from other fields of physics such as thermodynamics, electricity or optical physics etc.

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[15-20]. In this way we can talk about a new facet of econophysics, named fundamental or **phenomenological econophysics**. Both types and directions of econophysics are equally useful for modelling the economic processes or phenomena, resorting to the methods and laws of general physics or especially statistical physics.

In this paper we attempt to introduce an econophysics approach to modelling the investment process using the electrical field flow concept (the Gauss' Law) from electrostatic chapter of applied physics.

2. The Law of the Electric Field Flow (Gauss' Law) [21]

As it is known from the applied physics, the electric or electrostatic field (for idle electric charges) represents a special physical entity that characterizes the interactions between electrical charges.

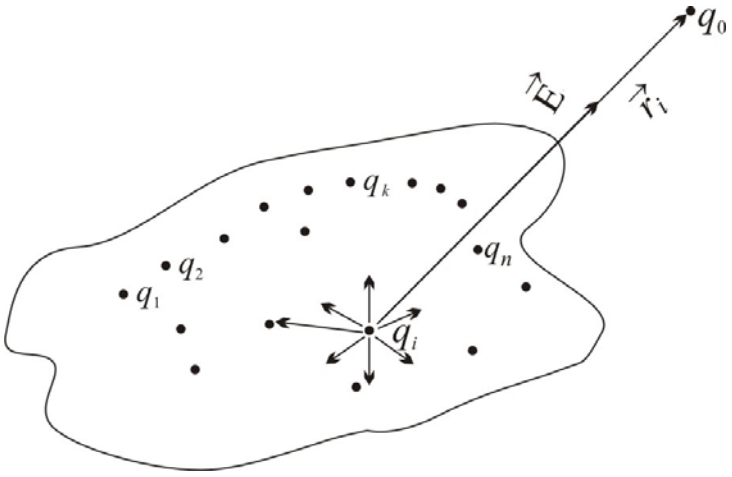


Figure 1. Electrostatic field created by electric charges q_1, q_2, ..., q_n.

In the case of the charges system q_1, q_2 … q_n in Figure 1, which is investigated (tested) with a very small charge q_0 named test or trial charge, the force F that results by summing the interactions of each charge q_i with the charge q_0, is given by the Coulomb's law, which describe the interactions between electrical charges [21]:

$$F = \frac{1}{4\pi\varepsilon_0}\sum_{i=1}^{n}\frac{q_0 q_i}{r_i^2}\cdot\vec{e}_i = q_0\sum_{i=1}^{n}\frac{1}{4\pi\varepsilon_0}\cdot\frac{q_i}{r_i^2}\cdot\vec{e}_i. \qquad (1)$$

where $\vec{e}_i$ is the unitary vector $\vec{r}_i/r_i$, and ε_0 is the vacuum electrical permittivity.

In equation (1), the constant q_0 appears as a proportionality factor with the term $\sum_{i=1}^{n} \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_i}{r_i^2} \cdot \vec{e}_i$ that depends only on the initial structure (without q_0) of the charges system q_1, q_2 … q_n and on the point's position (x_0, y_0, z_0) defined through the vector $\vec{r}_i$ (with the origin in charge q_i and the peak in the point where is q_0). This vectorial size, noted with $\vec{E}$ represents the electric field strength (or simply the electric field) generated by the charges q_1, q_2 … q_n, which are the field's sources:

$$\vec{E}(x_1, y_1, z_1) = \sum_{i=1}^{n} \frac{q_i}{4\pi\varepsilon_0 r_i^2} \cdot \vec{e}_i. \tag{2}$$

Taking into account (2), the equation (1) is written as:

$$\vec{F} = q_0 \vec{E}. \tag{3}$$

Resulting that:

$$\vec{E} = \frac{\vec{F}}{q_0}. \tag{4}$$

If in (4) is considered $q_0 = +1$, then the electric field will coincide in direction, size and sense with the force $\vec{F}$. Thus the electric field's strength $\vec{E}$ (x_0, x_0, z_0) in a random point in space is a physical quantity numerically equal to the force exerted by the electric field (produced by other charges) on a standard charge, equal to the unitary positive charge located in that point and having the orientation/direction of this force F.

The definition (4) admits an idealization, namely that the point like charge q_0 is the test-charge (sample-charge) which highlights the force $\vec{F}$, has to have a very small value, so that its presence doesn't disturb the investigated electric field.

The electric field can be created also by a single charge (macroscopic) with a size q (Fig. 2). In this case the electric field intensity in a point P_1 is given by a formula similar with (2) (without the part which contains the summation symbol $\sum$):

$$\vec{E}(x_0, y_0, z_0) = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2} \cdot \frac{\vec{r}}{r} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2} \cdot \vec{e}. \tag{5}$$

where ε_0 is the vacuum dielectric permittivity.

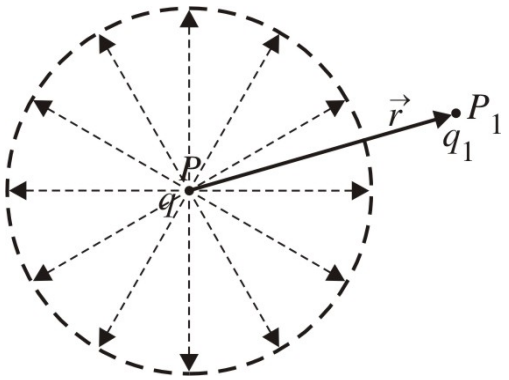


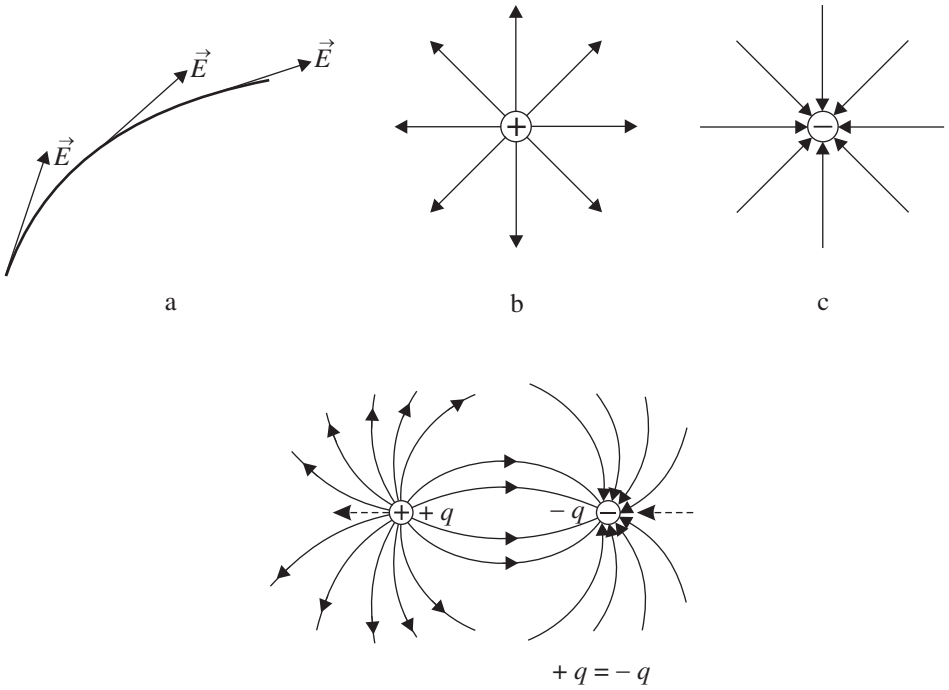
Figure 2. The electric field of an isolated charge q.

Here the charge q is the only source of the field E and $\vec{r}$ is the position vector of the point $P_1(x_1, y_1, z_1)$, where the field is calculated, its origin being considered in the point $P(x, y, z)$ where is located the charge q.

The electric field strength E characterizes the action exerted by the source-charge q on a small body with a punctual charge q_1. This action is exerted in all the directions competing in the point P, having the same intensity in all the points equally distant by P i.e. located on the surface of a sphere containing in its centre the charge q; then it's usual for this action to be inversely proportional to the sphere's area through which propagates. This is why in the Coulomb Law (see the equation (1)), the proportionality factor were chosen equal to $1/4\pi$, characteristic for the spherical symmetry effects. The same, this factor appears and in the formula of the electric field strength (see (2) or (5)) and in every formula in electricity referring to a phenomenon that presents spherical symmetry.

We can conceive a visual representation of the electric field by an image that emphasize the field's sources and the areas where are manifesting the interaction forces with other charges. To this end, for each point from space where the field manifests we can associate a vector determining the field's direction. Adopting a simplified representation (in plane) of the points where we can draw the origins of the field vectors $\vec{E}$ in the given plan, are considered the so called field lines whose tangents in any point coincide with the electric field direction in that point (Fig. 3,a). In this case, if the source-charges are considered fixed/stationary, and the test-charge will be let free, it will move on the trajectories that constitute the electric field lines and whose sense coincides, by convention, with that

in which would move the positive unitary charge. The field lines of an isolated point charge are straight lines that start radial from the charge if the charge is positive (Fig. 3,b) or come radial to it, if it is negative (Fig. 3,c). In the case where there is a two charges system that can interact, the field lines begin in the positive charge(s) and ends in the negative charge(s) (Fig. 3,d).



a b c d

Figure 3. a) field line; b) the electric field of an isolated positive charge $+q$; c) the electric field of an isolated negative charge $-q$; d) the electric field of two electric charges of contrary sings located close one to another and $+q = -q$.

Conventionally we may introduce as a measure for the electric field intensity by the **number** of field lines drawn in a given area, so by the field lines density. Therefore, if in the way of the field lines shall be perpendicularly placed a surface of a value equal with the unit (Fig. 4,a), the higher the electric field intensity E is, the larger will be the number of lines N crossing the surface.

It is conventionally considered that through the surface S perpendicular to the direction of the electric field, we can draw a number N

of field lines so that the number of field lines passing through the surface to be equal to the value of electric field intensity from the surface area (Fig. 4,a) i.e.:

$$\frac{N}{S} = E. \tag{6}$$

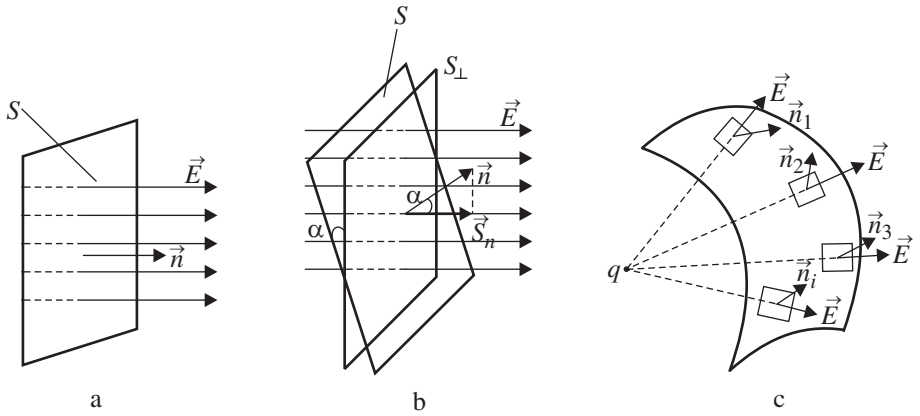


Figure 4. The definition of the electric field flow.

In this way, the field's intensity *E* value is related to the density of field lines. The equation (6) allows the introduction of a new physical quantity named **electrical flow** (or **electric field flow**) defined by the total number *N* of field lines that cross a surface *S* perpendicular to the direction of a uniform electric field $\vec{E}$ (Fig. 4,a); from equation (6) we can see that Φ (=*N*) is given by:

$$\Phi\ (=N) = ES. \tag{7}$$

In the case when the considered surface makes an angle α with the direction of the field lines, to define the electrical flow we can introduce the concept of oriented surface, given by the versor's sense $\vec{n}$ of the normal (Fig. 4,b) so:

$$\vec{S} = S\vec{n} \tag{8}$$

where $\vec{n}$ is the normal (unitary-vector) to the surface.

The flow through the surface inclined with an angle α to the field direction can be calculated either with the help of the projection of the surface *S* on the plane that is perpendicular to $\vec{E}$ (Fig. 4,b):

$$S_\perp = S\cos\alpha \tag{9}$$

or with the projection of $\vec{E}$ on the normal direction to the plan:

$$E_n = \vec{E}\vec{n} = E\cos\alpha. \tag{10}$$

In this last case, for the expression of electric field flow results:

$$\Phi = ES_{\perp} = ES\cos\alpha = \Phi_0\cos\alpha = E_n S, \tag{11}$$

where:

$$\Phi_0 = ES, \tag{12}$$

represents the maximum value of the flow, which would pass through a surface perpendicular to the field lines. (Fig. 4,a)

In case the surface is not plane, it is divided in small surface/area elements (elementary surfaces/areas) ΔS_i (Fig. 4,c) where the field's intensity varies very slightly, so that the field can be considered uniform within each elementary domain. The flow of the field lines through the entire finite area S is given by the algebraic sum of elementary flows (see equation 7):

$$\Phi = \sum_{i=1}^{n} \Delta\Phi_i = \sum_{i=1}^{n} E_{n_i}\Delta S_i. \tag{13}$$

The surface/area elements $\Delta\vec{S}_i = \vec{n}_i\Delta S_i$ must be taken infinitely small, so that the elementary flow dΦ that pass through dS will be:

$$\mathrm{d}\Phi = E_n\mathrm{d}S = E\mathrm{d}S\cos\alpha. \tag{14}$$

By integrating over the entire surface shall be obtained the total flow:

$$\Phi = \int_S E\mathrm{d}S\cos\alpha = \int_S \vec{E}\overrightarrow{\mathrm{d}S}, \tag{15}$$

where the surface $\overrightarrow{\mathrm{d}S}$ is considered directed after the normal $\vec{n}$ to the concerned element:

$$\overrightarrow{\mathrm{d}S} = \vec{n}\mathrm{d}S = \mathrm{d}S\cos a. \tag{16}$$

The flow of the field lines is positive when the field $\vec{E}$ has the same sense as the normal $\vec{n}$ and negative when the two vectors are directed in opposite senses.

Using the equations (5)-(7) we can calculate the electric flow of a point-charge q through a sphere surface of radius r centred in the point where the charge is (Fig. 5).

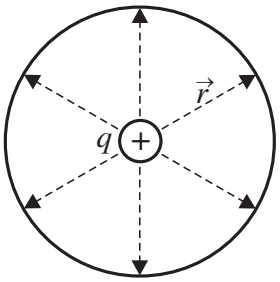


Figure 5. The electric field of a punctual charge located in the centre of a sphere with radius *r*.

Being a radial field and depending of the sphere's radius *r*, in all the points of the sphere surface will have a constant value (see equation (5)):

$$E = \frac{1}{4\pi\varepsilon} \cdot \frac{q}{r^2}. \tag{17}$$

Such as the normal $\vec{n}$ in each point coincides with the sphere radius, the flow calculation is done directly:

$$\Phi = ES = \frac{q}{4\pi\varepsilon r^2} \cdot 4\pi r^2 = \frac{q}{\varepsilon} \tag{18}$$

where ε represents the environment's permittivity[1].

The equation (18) is valid for any type of charge *Q* included within any closed area *E*, because every type of closed surface can be included in a spherical surface as the one in figure 5, to which are applied the formulas (12) and respectively (17) and (18).

For closed surfaces that aren't containing charges *Q*, the electric field flow will be equal to zero. These considerations underlying the Gauss'Law, which reads as follows [21]:

The total flow of the field lines through a closed area is equal to zero if the field sources are outside the volume enclosed by the surface S and equal to $\frac{Q}{\varepsilon_0}$ *when the charges Q are inside of the considered surface (Fig. 5) i.e.:*

$$\Phi = \oint_S \vec{E}\,\overrightarrow{\mathrm{d}S} = \begin{cases} 0, & \text{if } Q \text{ is outside of volume enclosed by the surface S;} \\ \dfrac{Q}{\varepsilon_0}, & \text{if } Q \text{ is inside of volume enclosed by the surface S.} \end{cases} \tag{19}$$

[1] In the case of the air is considered that ε has the value of the vacuum permittivity noted with ε_0.

If inside of the volume the charge Q_{int} is continuously distributed with a density $\rho(x,y,z)$ then Gauss' Law should be written as:

$$\Phi = \oint_S \vec{E}\,\overrightarrow{\mathrm{d}S} = \frac{1}{\varepsilon_0}\int_V \rho(x,y,z)\mathrm{d}v. \tag{20}$$

3. The econophysics model for investments based on microcredits or subscription of shares

In the proposed model the electric charges inside the enclosed surface being the sources of the electric field E are assimilated with financing sources, which can be banks or individuals etc., able to provide capital, i.e. the amount of money as microcredits or subscription of shares, in order to establish a company or any investment, which manifests similar to a electrical field (Fig. 1), named in the present case **investment field.** The field lines that start from the financial sources can be assimilated with microcredits for investments, so that the flow of the investment field Φ_i is defined by the total number N of microcredits similarly with the number N of electrical field lines in equation (6). If the enclosed surface S containing inside the financial sources from which start the microcredits lines, is considered as money source (money offer), which different investors may do in economic boom periods, then for the investment I can be written an equation similar to equation (6):

$$\frac{N\,(\text{microcredits})}{S\,(\text{money offers})} = I(\text{investment}), \text{ similarly to } \vec{E}\,. \tag{21}$$

In this way, the value of the investment field strength (i.e. the investments) is related to the density of the field lines (the microcredits flow). The equation (21) allows the introduction of an econophysics notion named **investment flow** (equal to the sum of total microcredits) similarly to the electric field flow, defined by the total number of field lines N (the total number of microcredits) that cross a surface S (the money offer) perpendicularly to the direction of a uniform electric field E (here equal with I = investments) (Fig. 4,a); then from the equation (21) we can see that $\Phi(=N)$ is given by:

$$\Phi\,(\textit{total microcredits}) = I\,(\textit{investments}) \cdot S(\textit{money offer}). \tag{22}$$

As was pointed out, in the case when the surface isn't plane, this is divided in smaller elementary surface elements ΔS_i (Figure 4,c) where the field's intensity varies slightly, so that the field can be considered uniform between the limits of each elementary domain. The investment field flow (total microcredits) through the entire finite surface *S* (money offer) is given by the algebraic sum of the elementary microcredits flows according to equation (12) and for the analysis of different situations the equations (12)-(20) are used.

Considering the Gauss'Law (see (19)) and eq. (22), the equation (21), expressing the value *I* of the investment can be written as:

$$I = \frac{\Phi}{S} = \frac{Q}{\varepsilon_0 S} = kQ \tag{23}$$

were the proportionality constant:

$$k = \frac{1}{\varepsilon_0 S},$$

depends on the money offer (through the factor $\frac{1}{S}$) and on the conditions for credit granting (the interest rate, payment terms, guarantees/securities etc.) expressed by the factor $\frac{1}{\varepsilon_0}$ where ε_0 represent a financial permittivity similar to environment's permittivity from (18).

4. Conclusions

Using the analogy between the electric field flow and the investment supply flow with microcredits, a new econophysics model for the investments is introduced and analyzed.

It shows that the investment value is determined by the volume of money sources *Q* and the money offer, but also by the concrete crediting conditions (guarantees, interest rates, payment terms etc.).

The equation (23) expresses a fact confirmed by the economic practice, namely that the investment value *I* clearly depends by the nature and value of the investment sources (noted by *Q*). The confirmation of this economic law is enhanced by a mathematical equation (see equation (23)) deducted based on the laws of physics, which is an exact science and at the same time are laws of nature science. Therefore, the confirmation to that

economic law (for investments) has the support of a high precision (specific for the exact sciences) and the validity of these equations being deducted based on the laws of physics in accordance with the laws of nature; this fact supports the economic law for investments showing that, as has been done so far, it is the most appropriate law for the analyzed economic process.

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A DRIFT FORMULATION OF GRESHAM'S LAW

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Abstract. *In this paper we analyze Gresham's Law, in particular, how the rate of inflow or outflow of currencies is affected by the demand elasticity of arbitrage and the difference in face value ratios inside and outside of a country under a bimetallic system. We find that these equations are very similar to those used to describe drift in systems of free charged particles. In addition, we look at how Gresham's Law would play out with multiple currencies and multiple countries under a variety of connecting topologies.*

Keywords: *Gresham's Law, Drift, Currency, Econophysics.*

1. An introduction to Gresham's Law

While the general mechanism of economics, adjustment of supply and demand by feedback through pricing, is generally known and appreciated, few specific economic laws have wide awareness outside of the field like Gresham's Law. Gresham's Law is the frequently quoted (or mis-quoted) statement regarding the circulation of multiple species of legal tender commodity money in an economy where the overvaluing or undervaluing of either relative to face value per unit weight can cause a rapid shift in the availability of both where one can become scarce while the other becomes plentiful. In its most widely known formulation it states, "bad money drives out good", which is a shorthand to indicate the over-valued commodity currency becoming the dominant means of exchange in the money supply while the undervalued commodity currency becomes scarce in circulation as it is hoarded or exported. This can also operate in monometallic commodity currencies with a debased versus more pure coin in dual circulation.

At the outset though, we need to be more specific in defining terms. As remarked by Mundell [1], a more accurate (though not perfect) statement of Gresham's law is "Bad money drives out good if they exchange for the same price". The concept of overvaluing or undervaluing commodity money is due to the fact that a coin of certain weight and purity has a defined legal tender value by the issuer but the underlying

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commodity, typically gold or silver, has its own demand separate from the demand for money in the economy. Therefore, there can be a disconnect when the market value of the commodity of which the money is made differs significantly from the required legal tender value. When this occurs, one species becomes overvalued ("bad") relative to the other currency while the other becomes undervalued ("good") relative to the first. Since people will try to use the cheapest coin in a transaction given the same face value, the depreciated coin circulates while the other is hoarded or sold for a profit.

Gresham's Law has been long known, even before Sir Thomas Gresham to whom it is attributed. In fact, Gresham himself did not purport to have discovered this law but rather it was attributed to him by the British economist Henry Dunning Macleod in 1858 [2] who believed Gresham had been the first to recognize this in a letter to Queen Elizabeth I advising her that the debasement of the coinage by her father Henry VIII had driven good coins out of circulation. The more exact stating of the phrase "bad money drives out good" was a paraphrasing of an anonymous 1696 pamphlet *A Reply to the Defence of the Bank, setting forth the unreasonableness of their slow payments*. Gresham's Law had been previously described even earlier by Nicole Oresme, a philosopher in the Middle Ages [3] and Nicholas Copernicus, who needs no introduction, in an essay on coinage for Sigismund I, King of Poland [4].

The operation of Gresham's Law has been viewed throughout history. In the Middle Ages there were three de facto commodity currencies: gold, silver, and copper and currency shortages due to debasement of one versus the other were common. There are also many recent historical examples. One is the ushering in of the global gold standard by the new nation Germany when in 1875 the Bank of Prussia declared it would only redeem banknotes in gold and not silver. While there were multiple causes for this, one was the decline in the silver price after large discoveries, particularly in the United States, which caused the silver coins to be overvalued relative to gold as the price of silver dropped. This caused an influx of silver into the country. The French led Latin Union and all other nations of Europe soon followed in demonetizing silver. Another example is in the United States where the de facto establishment of the gold standard in the United States was effected in 1834 by the 1834 Coinage Act which set the gold: silver price ratio at 16:1 versus the prevailing world market ratio of 15.6:1. This overvalued gold and caused an influx of gold and the opposite effect on silver. Gresham's Law would be continuously invoked using this and other examples in the fierce debates on bimetallism later that century.

2. Previous Views on Gresham's Law

Gresham's Law has been frequently investigated in economics as to ascertain its consistency and cause. Its consistency has often been questioned by the presence of historical periods where both overvalued and undervalued money circulates together, seemingly violating the dictum that the overvalued currency or coin should drive out the undervalued. This is described for the 19th century United States in [5] and Medieval England and France in [6-7]. In particular, the authors in [5] place even more restrictive bounds on the operation of Gresham's Law saying it shouldn't be considered a true “law” limiting it to small denominations and situations where the transaction cost of switching to overvalued money are low enough to make an exodus of undervalued money feasible. The investigation of cause has recently focused on the problem where there is private information asymmetry as to the real worth of the money by one side in the transaction. This develops a situation like the market for “lemon” used cars and under certain equilibria, Gresham's Law-like behaviour results. This line of inquiry was begun by [8] and continued in [9-11]. Importantly, however, these models also show there are alternate equilibria under varying conditions which contradict Gresham's Law i.e. debased and undervalued coins circulate together in an economy. This paper will not look at the causes of Gresham's Law from an economic perspective but rather investigate how and why its operation is so rapid in practice.

3. A Mathematical Illustration of Gresham's Law

In this paper, the key question we will address is how rapidly does commodity money outflow/inflow from a country when Gresham's Law comes into play. Evidence from times when Gresham's Law has operated in the past alludes that the process can be quite rapid for even small differential price changes. The outflow in both quantity and total value can be shown to be quite large even in the most marginal circumstances.

In figure 1 there are two countries (or a country and the wider market) which have open trade and capital flows allowing money of either species to circulate back and forth. If the ratio of the face values of the currencies in one country differs from the wider market, there will be net flows of each currency in each direction. Here we will first illustrate the case where

two species of commodity money, m_1 and m_2 circulate. Both have a global market price ratio of R, the ratio of the price of m_1 to m_2 and a local price in the domestic currency of P_1 and P_2.

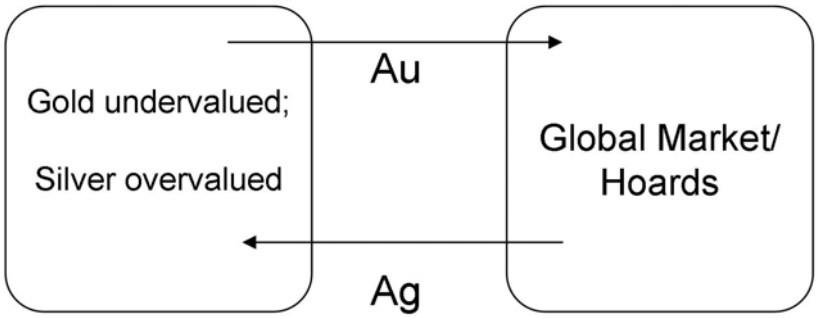

Figure 1. Illustration of Gresham's law at work in a gold/silver bimetallic economy where gold is undervalued and silver is overvalued so the Au/Ag ratio is lower than that of the wider market.

In addition, there are net demand functions for the commodity, $Q_1(P_1)$ and $Q_2(P_2)$ which describe the net demand curve for the currency over and above the demand for money when arbitrage opportunities emerge from mispricing. If $P_1/P_2 = R$ then $Q_1 = Q_2 = 0$. Further, assuming the overall money supply by value is unaffected, when Gresham's Law kicks in $P_1\, d\, Q_1 = -P_2\, d\, Q_2$.

Given the above, we can thus state the demand function for m_1 alternatively as $Q_1(RP_2) = 0$. The change of $Q_1, d\, Q_1,$ if there is a change in the face value of the coin from the market value of its metal can be given by:

$$d\, Q_1 = -\frac{d\, Q_1}{d\, P_1}\Delta P_1. \tag{1}$$

The negative sign is indicative of the fact that $\frac{d\, Q_1}{d\, P_1}$ is negative for demand and $\Delta\, P_1$ greater than zero indicates an overvaluation which triggers inflows. This can be further expanded using the basic equation for elasticity of demand where the demand elasticity for m_1 is E_d^1:

$$E_d^1 = \frac{P_1}{Q_1}\frac{d\, Q_1}{d\, P_1}. \tag{2}$$

The equations can be combined to conclude:

$$d\ Q_1 = -\ Q_1 E_d^1 \frac{\Delta\ P_1}{P_1}. \tag{3}$$

This shows that the differential quantity from equilibrium (in units of measurement such as tons) that flows out of the country is the product of the quantity demanded in the market, the elasticity of demand for the commodity arbitrage opportunity, and the % increase of the face value over market value for the money. If you want to look at the outflow in terms of the unit currency we use $d\ M(1) = d\ Q_1 P_1$:

$$d\ M(1) = -\ Q_1 E_d^1 \Delta\ P_1. \tag{4}$$

We use $d\ M(1)$ notation to differentiate from the money supply measure, M_1.

We can further reduce this by $\Delta\ P_1 = P_1 - RP_2$ to get:

$$d\ Q_1 = -\ E_d^1 \left(1 - \frac{RP_2}{P_1}\right); \tag{5}$$

$$d\ Q_1 = -\ Q_1 E_d^1 \left(1 - \frac{R}{R_c}\right) \tag{6}$$

where R_c is the bimetallic ratio in the country that differs from the market.

Obviously if $R/R_c = 1$ there is no net flow of currency. For the other species we have given $\Delta\ P_2 - P_1 / R$,

and:
$$d\ Q_2 = -\ O_2 E_d^2 \left(1 - \frac{R_c}{R}\right). \tag{7}$$

Given the above, why is the outflow so sudden and huge in the case where face values and market values are not equal? First, the elasticity of demand E_d is typically large (and negative) for the demand curves facing arbitrageurs [12]. This combined with a likely high demand Q_1 by the market for the undervalued currency means $R_c \neq R$ will cause a huge flow under even a small differential between the market and legal tender ratios. This effect is only delayed by factors such as transaction and transport costs, historically estimated at about 1% of face value for 19th century US coins. These factors show why bimetallic regimes are often unstable to

even small changes in the face value or market price of the commodity used as currency. If R is the Au/Ag ratio, when gold becomes overvalued, like the ratio being raised 16:1 by the 1834 Coinage Act instead of the 15.6:1 abroad, there is a positive net inflow for gold and the opposite for silver.

If there is a time constant, τ for the quantity of demand for a given currency, we can rewrite equation 6 as:

$$\frac{d\,Q_1}{dt} = -\frac{Q_1 E_d^1}{\tau}\left(1-\frac{R}{R_c}\right) \tag{8}$$

and show the quantity over time of a misvalued currency can be approximated by:

$$O_1(t) = Q_1(0)_e \frac{-E_\partial^1\left(1-\frac{R}{R_c}\right)}{\tau}. \tag{9}$$

As a final note, the fact that $P_1 dQ_1 = -P_2 dQ_2$ we have:

$$Q_1 E_d^1 \Delta P_1 = -\,Q_2 E_d^2 \Delta P_2; \tag{10}$$

$$Q_1 E_d^1 (P_1 - RP_2) = -\,Q_2 E_d^2\left(P_2 - \frac{P_1}{R}\right); \tag{11}$$

$$Q_1 E_d^1 R = Q_2 E_d^2; \tag{12}$$

$$\frac{E_d^1}{E_d^2} = \frac{1}{R}\frac{Q_2}{Q_1}. \tag{13}$$

4. Gresham's Law and Drift

For those familiar with physical processes of charge carriers such as those dealt with in plasma physics or materials science the equations above have a form that is qualitatively similar to charged particle drift under an external electric field. Whereas in those situations we have charge carriers of opposite sign, here we have currencies that are overvalued or undervalued. The classic charge density drift equation for a *DC* glow discharge plasma with a homogeneous electric field is [13]:

$$j = qn\mu E. \tag{14}$$

Where q is the unit charge of the charged particle, e in the case of electrons, positrons, or protons, n is the charged particle density, μ is the charge mobility, and E is the electric field strength. A more comparable formulation to equations 3 and 4 is:

$$j = qn\mu\frac{\Delta V}{d}. \tag{15}$$

The variable ΔV is the voltage difference and d is the distance between the electrodes. Roughly, the quantity demanded is comparable to qn, the demand elasticity to μ, and the price differential to ΔV. This is illustrated in figure 2. This analogy has also been demonstrated for general currency exchange by the authors of [14] comparing currency exchange to charge mobility in an electrochemical system.

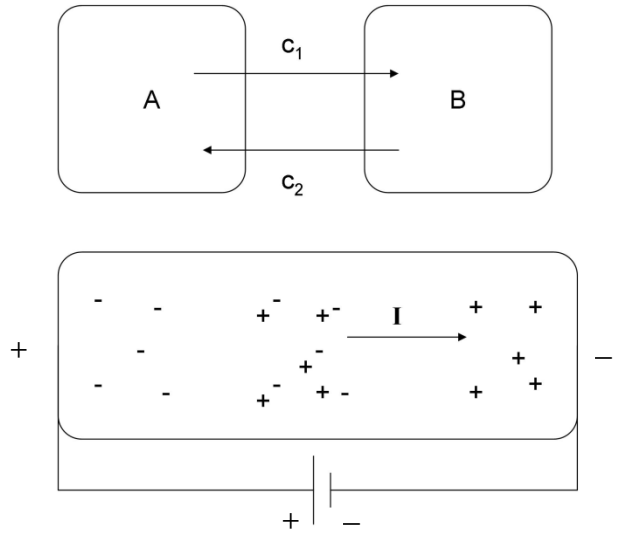

Figure 2. A simple representation of the similarities between currency movements under Gresham's law and electric particle drift.

5. Expanded models of Gresham's Law

For those interested in certain theoretical aspects of Gresham's Law beyond the real world typical case of bimetallic regimes, this section will address three cases of Gresham's Law under expanded scenarios of multiple currencies and countries. The number of currencies will be designated by n and the number of countries designated by m. First, we will look at the situation with $m = 2.$ countries and $n > 2$ currencies, then

$n = 2$ currencies with $m > 2$ countries, and finally the complex case of $m > 2$ countries and $n > 2$ currencies. In all cases, all n currencies are legal tender in all m countries and have face values assigned by each country. In addition, the set of the values of the currencies are ordered sets so that each currency has a relatively higher or lower value to the same currencies across all countries. Finally, currencies will be labeled with numbers and countries with letters.

A. Case of *m* = 2, *n* > 2

In this case, we have n currencies which will flow between the two countries in amounts corresponding to the number of available arbitrage opportunities. The value of any currency must be greater than zero so that the distribution of currency ratios for each currency pair in both countries is a closed set on $\mathbb{R}^+$. For each currency which has a face value that differs from the market value, it will have arbitrage opportunities against all of the other $n-1$ currencies as an outflow or inflow (or both). If a number of currencies C, have different face values than market value in the other country, we have $nC/2$ possible arbitrage pairs with a maximum of $\binom{n}{2}$ if everything is given a face value that differs from the market value abroad.

For a given currency, the net flow is given by:

$$\Delta Q_i = -\sum_{j=1}^{n} Q_{i,j} E_{d(i,j)} \left(1 - \frac{R_{i,j}}{R_{c(i,j)}} \right). \tag{16}$$

Next we assume the demand function, and thus E_d and Q are identical across currency pairs for simplification:

$$\Delta Q_i = -QE_d \sum_{j=1}^{n} \left(1 - \frac{R_{i,j}}{R_{c(i,j)}} \right). \tag{17}$$

From equation 17 we can see that the summation can be simplified to $n - \sum \frac{R_{i,j}}{R_{c(i,j)}}$ and thus the sum that determines the magnitude and direction of a currency's flow is:

$$\frac{1}{n} \sum_{j=1}^{n} \frac{R_{i,j}}{R_{c(i,j)}}. \tag{18}$$

If this quantity is less than 1 for a currency we have a net inflow, otherwise there will be a net outflow. From this it is obvious that the adjustment of the face value of just one of the currencies is enough to unsettle the entire equilibrium of currency flows between the two countries. For example (see figure 3) imagine we have two countries, *A* and *B*, with five currencies, 1 to 5. The value ratio of the currencies increases monotonically for a lower number over a higher number with $P_1 / P_2 > 1$ and the highest ratio of all being P_1 / P_5. If country *B* overvalues currency 2, but not so much that $P_1 / P_2 < 1$, it will cause a drift in all the currencies. There will be a net inflow of currencies 1 and 2 since 2 is overvalued versus 3, 4, and 5 and 1 is overvalued versus 2. Currencies 3-5 will outflow since they are now relatively undervalued but 2 will also outflow since it is now undervalued with reference to currency 1. The net flow of currency 2 will depend on the relative volume of the arbitrage opportunity in each direction.

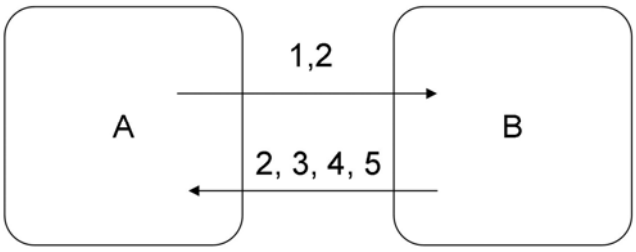

Figure 3. The effect of overvaluing currency 2 in country *B*.

B. Case of *m* > 2, *n* = 2

In this case, we have multiple countries but only two currencies. At first glance, it would seem we could expand equations 3 and 6 to the case of summations across multiple countries to find the drift amount for currencies 1 and 2 in any given country *i*. However, here the actual behaviour departs from idealistic physics characterizations and comparisons with charged particle behaviour. With only two currencies and multiple countries there are multiple opportunities for arbitrage and given that the cost of transaction and transportation are similar, currencies will flow to the most profitable opportunity. So for currency 1 in a country *i* the change to due arbitrage opportunities across all other countries indexed by *j*, we have:

$$\Delta Q_1(i) = - Q_1 E_d \max_j \left(1 - \frac{R(j)}{R_c(j)} \right) . \qquad (19)$$

The implication from the maximization is that we minimize the quantity $\frac{R(j)}{R_c(j)}$. Further, the flow of currency 2 in the opposite direction is given by:

$$\Delta Q_2(i) = -Q_2 E_d \min_j \left(1 - \frac{R_c(j)}{R(j)}\right). \tag{20}$$

The minimization occurs given the flow is the opposite direction (negative) of currency 1. So here we must maximize $\frac{R_c(j)}{R(j)}$. Given this is the inverse of the previous minimization of $\frac{R(j)}{R_c(j)}$ we find that the same country is the target of inflows and outflows of both currencies. If we consider the relative values of the currencies to be ordered sets with the same relative rank order for each currency in all countries, all countries will send the overvalued currency and receive the undervalued currency from the country with the most lopsided ratio. This is illustrated in figure 3 and 4 where currency 2 is most overvalued in country *B*.

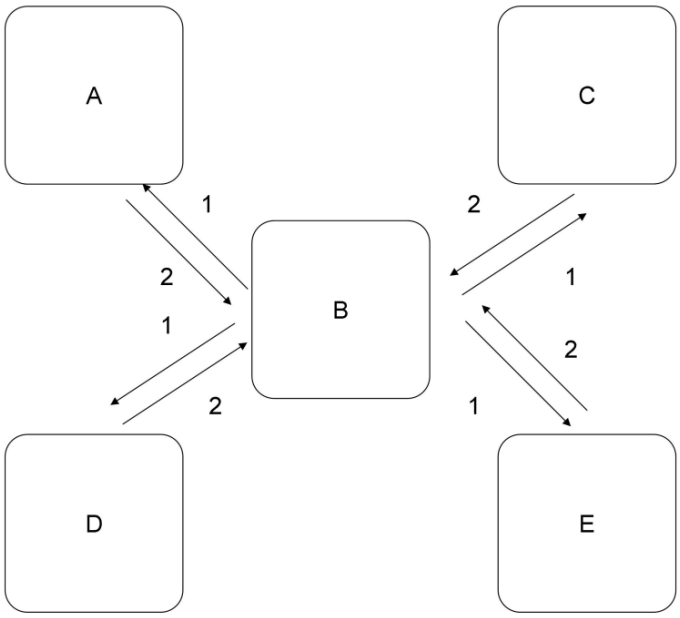

Figure 4. The flows of currencies for $n = 2$ and $m > 2$.

C. Case of *m* > 2, *n* > 2

In the most complex case, it would seem nearly intractable given that at maximum disequilibrium you could theoretically have a $\binom{n}{2}\binom{m}{2}$ number of possible arbitrage trades. Granted, such a situation is likely never to arise since the proliferation of so many types of legal tender would defeat the purpose of money as a unit of exchange in the first place. In this situation, though, a similar maximization strategy would appeal since in any country i, the currency j would be sent to country k where it is most overvalued relative to other currencies. In fact, if all m countries are connected as in a complete graph, there is a country for each currency where it is most overvalued relative to its value in all others since the value of the currency must be positive. All other countries will send currency inflows of currency j to this country given it provide the maximum return.

It is possible for one country to have multiple currencies that are most overvalued, but each currency must have at least one country where it is most overvalued, multiple if some countries have the same relative value to the lowest currency. Again assuming a generic demand function for each currency to keep the quantity demanded and elasticity constant,

$$\Delta Q_j(i) = -Q_j E_d \max_{(k,l)}\left(1-\frac{R_{(j,l)}(k)}{R_{c(j,l)}(k)}\right). \tag{21}$$

Again, we have to minimize $\frac{R_{(j,l)}(k)}{R_{c(j,l)}(k)}$ to maximize the entire argument. The lowest valued currency, with a default relative value of 1 in the ordered set, is thus undervalued in every country that has another currency most overvalued and flows out to all the other countries as the opposite outbound flow. Therefore, steady state will be a group of countries with only the currency (ies) that they most overvalue while the least value currency circulates throughout the other countries.

Another possible situation under this model is where the topology is not one of a complete graph where every country (node) can have an inflow or outflow of currency to another. This could likely cause local maxima to arise given some nodes are not connected to the others where the currency is most overvalued. Indeed this is the case. In figures 5, 6, and 7 we show the result of $m=10$, $n=5$ on the topologies of a complete graph, a random network, and a scale-free network.

In each graph, the red nodes indicate where one or more currencies are locally overvalued and thus have inflows from other nodes. Only in the complete graph are the red nodes indicative of global overvaluation since each node connects to every other. The latter two topologies have more nodes where currency is locally overvalued and have inflows despite not being a global maximum. Indeed, if one repeats the simulation 1000 times we find the results in the Table 1 to show that there are more local maxima due to inhomogeneities in these stochastic graphs than the complete graph situation. Therefore, overvaluation and undervaluations of currency are more likely to cause local rather than global flows across all the countries.

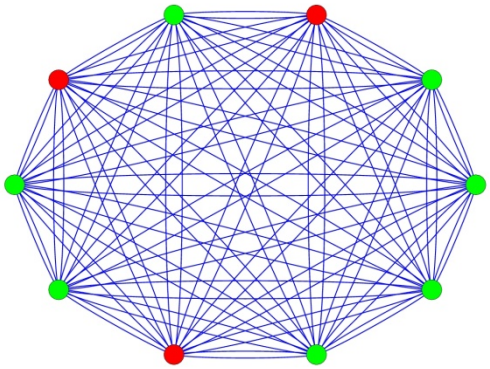

Figure 5. Complete graph of $m = 10$ with $n = 5$. Red nodes show countries with inflows of overvalued currencies.

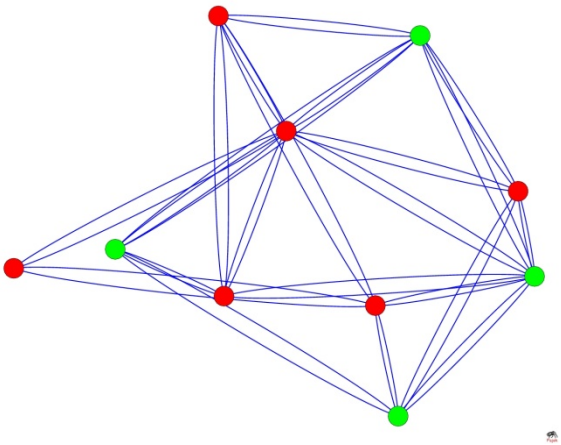

Figure 6. Random graph of $m = 10$, $n = 5$ assuming $p = 0.48$ for graph creation. Red nodes show countries with inflows of overvalued currencies.

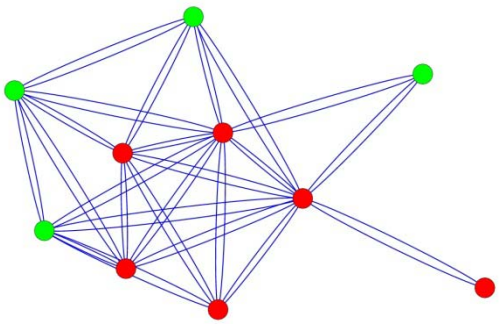

Figure 7. Scale-free graph of ‹*k*› = 4.8. Red nodes show countries with inflows of overvalued currencies.

Table 1.
The mean and standard deviation of the number of vertices with locally overvalued currencies by topology from a 1000 run simulation where $m = 10$, $n = 5$, and ‹*k*› = 4.8 for the complete, random, and scale-free networks.

	Complete	Random	Scale-Free
Mean	3.9	6.4	5.8
Standard Deviation	0.9	1.3	1.4

6. Conclusion

Gresham's Law may not rise to the level of a principle of physics and indeed even in economics it is often carefully handled. For example, it does not apply to paper money where you can often have dual circulations of different banknotes in an unofficial capacity without one driving the other out of circulation. This is often seen with dollars in many countries, especially in the Western hemisphere, Euros in parts of Eastern Europe not yet on the currency, and the Renminbi in Hong Kong and Southeast Asia. In these cases, only one currency is legal tender and while one may have more value in the sense of relative exchange rates of fiat money, the bill itself has no underlying value.

In this paper it has been demonstrated that Gresham's Law is a phenomenon quite similar to drift where the difference in valuation sets up pull similar to a potential that drives inflows and outflows of currency in a bimetallic regime. The rate of this flow is rapid due to its relation with the usually large elasticity of demand for arbitrage and is also proportional to the degree of imbalance between the ratios of the two currencies in the country and outside of it in the wider market. Free flow with negligible

costs and delays between countries leads to a relatively few countries with the highest overvaluation receiving inflows of all but the lowest denominated currency while connections through more complicated types of networks lead to inhomogeneities and local minima for currency inflows and outflows. In the end, however, in almost all scenarios bimetallic or multimetallic currency regimes are extremely unstable to fluctuations in the face value that differ from market value. It is partially for this reason that they were not preferred standards in the latter half of the 19th century.

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NEW ECONOMY Section

RIGIDITY OF THE ROMANIAN LABOUR MARKET. THEORETICAL AND EMPIRICAL APPROACH[1]

Elena PELINESCU[*]

Abstract. *This paper studies the rigidity of the labour market in the context of accession to the Economic and Monetary Union, moment after which Romania will not be able to use the exchange rate as an adjustment instrument in front of economic shocks. Since 2001 government policies have reduced the institutional rigidity of the labour market: the government intervention has decreased and the negotiation of employment contracts has moved from national to industry or company level, making it easier for the companies to adjust wages and withstand shocks. The empirical analysis, based on a multiple linear regression, shows that wages are in connection with macroeconomic variables such as inflation, GDP and non-wage costs. Union power in wage negotiations is highlighted by the positive relationship between the average wage and the minimum wage.*

Keywords: *labour market, rigidities of labour market, regression, business cycles volatility, persistent inflation.*

1. Introduction

A vast literature discusses the labor market rigidities and their major influence on the ability of the income policy, especially the wage policy, to absorbe shocks in the economy. Literature in the field emphasizes three aspects of labor market rigidity, widely debated in terms of ability to adjust wages, namely: i) the impact of labor market institutions with emphasis on the influence of trade unions and collective agreements ii) the influence of employee protection legislation and iii) wage formation mechanism affecting nominal and real wage rigidity. All these factors influence the labor market rigidity with significant effect on the ability of economies within the euro area to absorb economic shocks.

[1] This paper is parts of the research program for the 2011 of the Romanian Academy and the Institute of the Economic Forecasting: *Romanian Economy and the EURO system*.

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Pissarides (1997) considered that short-term problems arising from wage rigidities are more serious within the euro area than outside it because normally "exchange rate is the first variable which is adjusted to market shocks and initiates changes in relative prices" (Pissarides, 1997, p. 520).

The labour market is greatly influenced by the ability of firms to move production from one location to another which creates a pressure on reducing taxes, salaries and social security system (Jepsen, Mary A., Pascual S., 2004).

Highlighting the importance of this theme we address aspects of labour market rigidities in Romania, being aware that in the context of accession to the euro area, knowing the labour market capacity to absorb economic shocks is extremely important.

This paper is organized as follows: the first part will present a brief overview of some of the findings in literature on this topic. The second part will deal with labour market rigidity in Romania by examining a model based on various components of labour market response to shocks in the economy. The third part will contain the conclusions.

2. Rigidity approaches in literature

Economic theories regarding wage rigidity (implicit contract theory and efficiency wage theory[2]), according to Stiglitz (1984), do not explain in a convincing manner neither cyclical unemployment nor macro-economic cycles. He believes that even newer versions that incorporate asymmetric information in contracts theory cannot explain some of the observable behaviour of unemployment, but the approach in terms of both theories can provide a satisfactory explanation. According to Stiglitz, firms have two reasons to pay high salaries: the first is to ensure employee productivity and, second, to reduce costs of future recruitment. Furthermore he believes that the companies reluctance to reduce wages in spite of the oversupply of labour assumes that employee productivity depends on the wage (ie productivity is a function of wages).

Studies in the literature on wage rigidity have a wide variety of approaches: analysis regarding downward wage rigidity and the impact on effectiveness of monetary policy; the influence of wage dynamics on monetary policy and inflation in particular; the relationship between

[2] Worth mentioning here the contracts theory and the fairness theory by Wolfgan F. and F. Pfeiffer (2006), *Reason for Wage Rigidity in Germany*, IYA DP 2017

wage policy in the public sector and budgetary balance; the relationship wages-competitiveness, wages-labour productivity; the relationship between wages and employment (wages-unemployment) and the effect of labour market institutions on volatility of business cycles.

Several conclusions can be drawn from the literature dedicated to this area of research:

1. *Institutional characteristics of labour market* are influenced by the type of labour contracts, by the bargaining power of unions which depends on the number of members, degree of association of trade unions into confederations, the degree of employee protection provided by national legislation[3], the minimum wage level. Studies have shown that institutional rigidities reduction through higher legislation flexibility[4] and the transition from national or sectorial negotiations (associated with greater rigidity in wage determination – see Holden and Wulfsberg, 2008, Babecký and all, 2010), to individual level negotiation increases the firms ability to react more quickly to different shocks in the economy. If the legislative protection of employees is associated with long-term contracts at company level then the downward wage rigidity is higher (Dabušinskas Room, 2011).

2. *The link between trade union density and business cycles volatility* was studied by Scharler and Rumler (2009) and their conclusion was that strong unions are less favourable to a policy of wage moderation in case of adverse shocks, thus increasing the volatility of the business cycles. However, the extent to which trade unions internalize the macroeconomic consequences of their actions has implications for macroeconomic output variables. Ie*, characteristics of the wage bargaining institutional process influence the response of macroeconomic variables to disturbances. Thereby, trade unions, in a coordinated system can provide an adequate degree of real wages flexibility in order to promote macroeconomic adjustment.*

[3] OECD has developed a methodology for determining the intensity of employee protection legislation in the 15 euro-area countries – EPL index with a scale of 0-6 where 6 is the strictest regulatory and 0 the lowest. The methodology was extended by Tonin (2004) to new countries of the euro area, data showing that EPL tends to be stricter in the EU compared to other countries – see Tairi Rõõm and Aurelijus Dabušinskas, 2011, *How Wage Respond to Shocks Asymmetry in the Speed of Adjustmen*t, Working Papers Series, no. 1340, 2011, European Central Bank.

[4] Holden (2004) developed a theoretical model which revealed a strong relationship between strict protection of employees by legislation and high downward wage rigidity. See Holden, S. (2004), *The Cost of Price Stability – Downward Nominal Wage Rigidity in Europe*. Economica, No. 71, pp. 183-208.

3. *Macroeconomic implications of trade unions and collective bargaining on wage rigidities* were highlighted by Calmfors and Driffill (1988). Their primary analysis is focused on unemployment and argue that the way wage bargaining is organized affects output, but without answering the question on the extent to which unions internalize the consequences of their actions given that absorbing the shocks implies an adjustment of real wages. For example, if a shock leads to decreased activity and increased inflation, unions response demanding higher nominal wages to compensate for losses in purchasing power of workers, leading to spiralling inflation and an increase in the production costs due to higher salary and lower production.

4. Peltzman (2000), referring to institutional rigidities, stated that *concentrated power in the labour market*, reflecting the oligopolistic nature of the participants in the labour market *is positively associated with asymmetries in price behaviour which tend to react more quickly to a decrease in demand*.

5. *Asymmetric reaction intensity of the economy to shocks is positively influenced by how the wages are adjusted*. The literature presents two approaches: adjustment depending on time and adjustment depending on the adjustment of salaries in the public sector. Studies show that countries where salaries are adjusted according to the public sector rules (for example Estonia where 58% of companies adjust their salaries based on this system) have a higher wage asymmetry. (Rõõm and Dabušinskas, 2011).

6. *Speed of adjustment to shocks increases when flexible wage component is higher*, usually companies linking the size of this component to the company's economic performance. However, the link between stimulus size and speed of response to shock is negative rather than positive (Dabušinskas Room, 2011).

7. *Rigidity of wages and price rigidity generates inertial inflation and persistent fluctuations in gross domestic product (GDP) causing a shift between volatility of inflation and volatility of GDP, which makes a strict policy of inflation targeting not to be an optimal monetary policy strategy*. (Cashew, Fuss and Wintr, 2009). Complementing this idea, Akerlof et al. (1996) believes that an inflation rate too low (near zero) will lead to increased unemployment and a GDP at a suboptimal level. In this context it is appropriate to distinguish between nominal wage rigidity and real wage rigidity, because *in case of real wage rigidities, monetary policy will not have an adjustment effect on labour market.*

A number of studies have revealed that differences in wage rigidity between countries can be explained by different degree of syndication, by the area covered by collective agreements, by labour protection laws, by the centralized coordination of wage bargaining, which can all be resumed as the institutional rigidity of the labour market. Moreover, wage rigidity across sectors was attributed to the ratio of sector employees to capital intensity, ratio of officials (white-collar employees) to workers (blue collar employees).

Starting from the idea that wage rigidity affects employment and unemployment Cashew, Fuss and Wintr (2009) measured downward wage rigidity based on the methodology developed by Dickens and Goette[5] (2006). They showed that *downward rigidity is greater in case of white-collar workers and lower in areas of blue collar employees and for those who receive bonuses*. Apart of the effect of labour force composition, they highlight factors that influence differences in downward wage rigidity: firm's size, the degree of competition, technology, wage bargaining institutions. Thus, *wages are more rigid in more competitive sectors, in the labour-intensive sectors and in sectors where wages are mainly centralized, set at sector level, compared with sectors where negotiations are at the firm level.*

8. Kai Christoffel and Tobias Linzert (2005) showed that *wage rigidity explains persistent inflation*. Using a New Keynesian dynamic stochastic general equilibrium model they argued that *i) the dynamics of inflation and unemployment depend also on other labour market fundamental factors such as labour protection and collective bargaining; ii) the volatility of the labour market flows increases salary adjustments and tend to increase the persistence of inflation* and *iii) labour market plays an important role in the transmission mechanism of monetary policy.*

3. Rigidity of the labour market in Romania. Empirical analysis

In Romania as in all European countries, an important role in wage formation mechanism is held by collective agreements, effective on more than a year, at branch, district or country level. Due to these contracts, the

[5] Stiffness estimation methodology, described by Dickens and Goette (2006), is developed within the International Wages Flexibility Project. According to this methodology, downward wage rigidity is defined as the share of employees who wish to receive nominal salaries frozen if they are confronted with a real reduction (nominal) wages. This methodology was applied in studies conducted by Wage Dynamics Network.

response of wages to business cycles is delayed by a period that depends on the duration of these contracts and their level of aggregation.

Romania, as part of the European Union has launched a comprehensive reform of the labour market, in the sense of a greater flexibility, aimed to change the law on collective agreements (certified nationally by Law 130/1996 – which states that the contracts should be concluded for a four years period, and eliminated by Law 62/2011 on social dialogue, through which collective bargaining is permitted only at smaller level: sector, branch, unit, group of units) and employee protection legislation (Labour Code, the social benefits etc.).

Analysis of the negotiation of employment contracts in Romania (Wcoord) and government intervention in these negotiations (Govint) reveals that during 1993-2010 the level varied by a maximum of collective bargaining in 2001, 2002, 2005 and 2006 when trade unions have negotiated contracts across the economy, with further negotiations at sector or industry level (level 4 on Kenwort intensity scale[6]) compared with the two remaining years when the level is representative for a joint negotiation at industry and company level with a low power of collective agreements at industry level (Figure 1).

Collective bargaining agreements set the level of wages usually over more than a year. This may lead, sometimes, to the decoupling of the wage dynamics from the labour productivity evolution, companies having limited freedom to adjust salaries in case of shocks. This explains the pressure to limit collective bargaining, a process made difficult by strong unions or state interventions in setting salary levels.

In terms of government intervention in wage determination, in Romania since 2001, there has been an indirect, limited state involvement in setting wage levels – indirect intervention referring to the wage indexation system, establishing minimum threshold requirements (the minimum wage) or that the private sector wages follow the development of public sector wages. In Romania there has been a shift from a position in which the state may or may not be required to interfere if wage negotiations failed (level 5, between 1993 and 2000) to the one in which the state sector wages are milestones guiding private sector wage policy (level 3 as shown in figure 1).

[6] Note: This classification is based on the Kenwort 5 points score methodology (Kenworthy, 2001a, b) on coordination in wage determination. For most of the periods, the score of the indicator noted *Wcoord* is the same except in cases of governments intervenes directly in wage setting (for which the score is 5). The evaluation considers an identical scale of 1 to 5 for government intervention in wage determination, wage level 5 means wages being imposed by the government in the private sector (the indicator for this is *Govint)*.

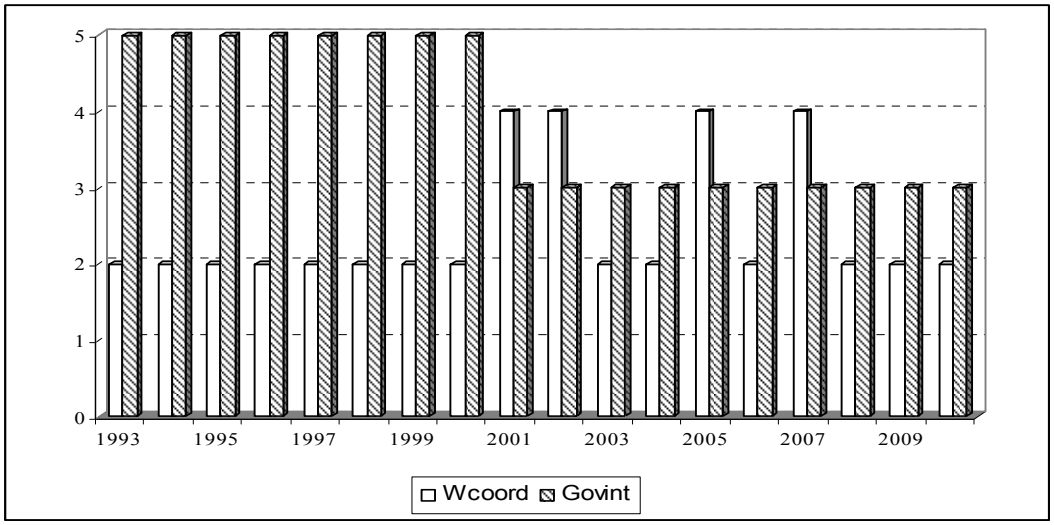

Figure 1. The level at which wage negotiations take place in Romania.

Note: Wcoord indicates the level at which wage bargaining takes place and is rated on Kenwort scale from 1 to 5 with the following meaning: 5. negotiations at national level strengthened by agreements between trade unions and employers or salary caps imposed by governments; 4. mixed negotiations at industry and economy level; unions negotiate permissive agreements at national level; key unions and employee associations negotiate for the entire economy; 3. industry-wide negotiations with or without setting caps; limited involvement of central organizations and a limited freedom for negotiations at company level; 2. joint or alternative systems of negotiations at industry and firm level with a reduced mandatory part at industry-wide negotiations; 1. fragmented negotiation, often at the firm level.

For Govint a 1 to 5 scoring system is used, similar to that applied by Hassel, 2006, p. 75, with some modifications: a) to mark the differences between the social pact case and the negotiated pact case (level 4); no government implication (level 5) which may or may not be requested to interfere when negotiations fail; b) to add the role of public sector in wage setting (level 3, the public sector is used as an example in the evolution of private sector wage) c) to grant more arbitration power to the Parliament or state in case of dispute resolution (level 2) and d) to distinguish the case of non-intervention of government in facilitating negotiations for large organizations (level 2) from the pure liberal or pluralistic non-intervention case to a liberal pluralistic regime in favour of companies trade unions and / or individual negotiations (level 1).

Source: ICTWSS: The Database on Institutional Characteristics of Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, compiled by Professor Jelle Vissert the Amsterdam Institute for Advanced Labour Studies, May 2011.

The level at which wage bargaining takes place in Romania is similar to that in other countries like the Czech Republic, Hungary, Slovakia, Bulgaria, France, Luxembourg and Ireland, as shown in figure 2.

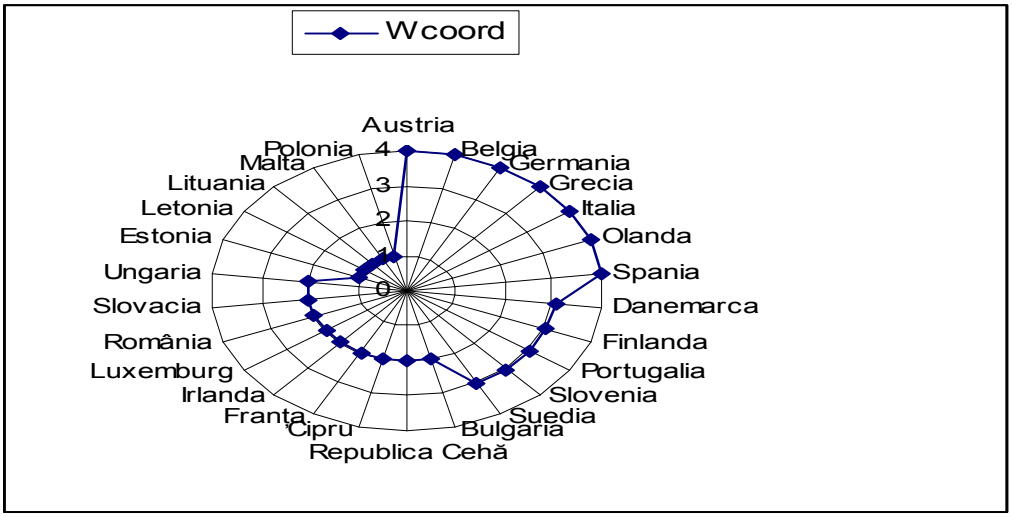

Figure 2. The level of wages negotiation in Romania and other countries in 2010.

Source: ICTWSS: The Database on Institutional Characteristics of Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, compiled by Professor Jelle Vissert the Amsterdam Institute for Advanced Labour Studies, May 2011.

This level is still high compared to other countries that have a more flexible market (USA, United Kingdom, Poland, Malta, Latvia, Lithuania) and where the coordination of collective bargaining is done at the company level (level 1 on Kenwort scale). Among the euro area countries a heterogeneity exists in the coordination of wage negotiations: in countries like Germany, Greece, Austria, Belgium, negotiation is done at industry and national level (level 4 on Kenwort scale), compared with mixed systems negotiations at the firm and industry level (level 2 on Kenwort scale) that are found in France, Ireland, Luxembourg.

The bargaining power of trade unions and professional organizations depends on their degree of concentration in confederations, on the one hand, and union membership of employees, on the other. Thus, as the number of members is higher, the bargaining power of unions is higher, which is evidenced by a higher index of union density, calculated as a percentage of net salaries of union members in total net salaries, as resulting from data in Table 1.

Table 1
Union density in the EU and other countries

Country	1990	2000	2007	2009	2010
Austria	46,9	36,6	33,3	28,6	28,1
Belgium	53,9	49,5	52,9	51,9	...
Bulgaria	81,2	27,7	20,0	19,8	...
Czech Republic	...	27,2	17,9	17,3	...
Cyprus	76.0	65.5	58.9[1]	54,3[2]	...
Denmark	73,5	74,2	69,1	68,3	....
Estonia	61,9	14,9	7,3	6,7	...
France	9,9	8,0	7,6	7,6[2]	...
Finland	72,5	75,0	70,3	69,2	70,0
Germany	31,2	24,6	19,9	18,8	18,6
Greece	34,1	26,5	24,5	24,0[2]	...
Ireland	56,7	40,4	32,2	33,7	**...**
Italy	38,8	34,8	33,5	34,7	35,1
Luxembourg	46,4	42,5	38,7	37,3[2]	...
Lithuania	32,7[3]	19,9[4]	8,8	9,5	...
Latvia	28,3[3]	...	16,3	14,8[1]	...
Malta	66,3	60,2	54,7	51,0	...
Netherlands	27,0[5]	26,0	20,0	19,0	....
Poland	30,4	42,2	15,2	15,1	15,0
Portugal	28,0	21,6	20,8	20,1	19,3
United Kingdom	39,3	30,5	28,3	27,5	...
Romania	**80,2[6]**	**45,1[7]**	**34,4[1]**	**32,8[2]**	**...**
Slovakia	67,3[8]	32,3	18,8	17,2[2]	...
Slovenia	61,1	43,1[7]	...	29,7[2]	...
Spain	12,5	16,7	14,9	15,9	...
Sweden	81,5	80,1	71,1	68,8[2]	68,9
Hungary	83,1	21,7	16,9	16,8[2]	...
Japan	...	21,5	18,1	18,5	18,5
USA	15,5	12,8	11,6	11,8	11,4

Note: ... data not available; 1 = year 2006; 2 = year 2008; 3 = year 1995; 4 = year 2001; 5 = year 1992; 6 = year 1991; 7 = year 1998; 8 = year 1993

Source: ICTWSS: The Database on Institutional Characteristics of Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, compiled by Professor Jelle Vissert the Amsterdam Institute for Advanced Labour Studies.

It is noted that Romania and other countries have seen a continuing reduction in union density, a rate of 32.8%, in 2008, positioning it among countries with medium density, compared with peak levels in northern European countries (Norway, Finland, Sweden and others).

To highlight the influence of wage evolution on macroeconomic variables a model was built based on a multiple linear regression between

the index of average gross nominal wage in the economy (ISAL_B_SA) as dependent variable and the following explanatory variables: GDP deflator index (IDEF_PIB_SA), GDP index (in constant prices 2000, IR_PIB_SA), growth rate of non-wage costs (R_COST_NESAL_SA), the minimum wage index (ISAL_MI_SA), growth index of M2 in EU definition and a dummy variable (dummy1) representing the policy measure to reduce wages by 25% in the public sector in July 2010 (which was assigned 1 for 3rd Quarter 2010 and 0 otherwise).

The model was developed with EViews, using quarterly data from Q1 2000 to Q4 2011. Series were seasonally adjusted using X-12-ARIMA program and were tested for stationarity – according to ADF and Philips Perron test results all series are stationary. The model has an R sq. value of 0.8486, R sq. adjusted of 0.8247, while the DW value is 2.23, indicating no error autocorrelation. Statistical tests (hypothesis tests on errors and the four coefficients) indicate that the regression model assumptions are met.

The resulting equation is:

$$
\begin{aligned}
ISAL\_B\_SA = {} & -0.31798 + 0.07239 \cdot ISAL\_MI\_SA + 0.09867 \cdot IM2\_SA(-1) + \\
& \quad [2.0977] \qquad [2.16294] \qquad\qquad [2.40445] \\
& \quad (0.0.052) \qquad (0.0335) \qquad\qquad (0.04104) \\
& + 0.56764 \cdot IDEF\_PIB\_SA(-1) + 0.25683 \cdot IR\_PIB\_SA + \\
& \quad [5.43079] \qquad\qquad [1.78556] \\
& \quad (0.10452) \qquad\qquad (0.14384) \\
& + 0.00062 \cdot R\_COST\_NESAL\_SA - 0.0298 \cdot DUMMY1 \\
& [+4.5440] \qquad\qquad [-1.86876] \\
& (0.00071) \qquad\qquad (0.01599)
\end{aligned}
$$

Data in square brackets are t-statistic values while the errors can be found in the parenthesis.

Results show that all coefficients have the expected sign, in accordance to economic theory. The coefficient for GDP deflator variable is significant, indicating that wage policy in Romania is affected by inflation, as ex-post indexation mechanism applied in public sector wages and extended to many companies. It is noted that, usually the wage adjustment is smaller than the inflation index given by the GDP deflator, an explanation being that in Romania indexing is done by consumer price index.

Union power in wage negotiations is highlighted by the positive relationship (coefficient + 0.11) between average monthly nominal gross

wage growth and minimum wage growth, trade unions seeking to protect employees in front of companies that are trying to provide salaries below the minimum wage.

There is a significant positive correlation (coefficient + 0.2568) between real GDP growth, money supply growth (coefficient + 0.0986) and average monthly nominal gross wage growth, as expected.

Also it is noted that the non-wage component has a great statistical significance (t statistic more than 2). The coefficient is small, above zero. Decision to reduce wages significantly affects the growth of average monthly nominal gross wage, the coefficient is negative (– 0.0298).

4. Conclusions

The analysis performed shows that the labour market in Romania was quite stiff. Government policies meant to improve flexibility (social aid law, the unions' law, retirement law, unitary pay law, the new Labour Code) were needed to insure greater support in front of labour market shocks, as Romania will lose the exchange rate policy through accession to the EMU.

Regression results revealed a correlation between the average gross wage and a number of fundamental variables which have a major influence on its evolution: the growth rate of real GDP, inflation, wage policy decisions in the state sector, bargaining power of unions in setting the minimum wage.

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ASSESSING THE LINKS BETWEEN WAGE SETTING, COMPETITIVENESS, AND IMBALANCES http://gesd.free.fr/wagecomp11.pdf

ANNEX 1

Regression equation

Dependent Variable: ISAL_B_SA
Method: Least Squares
Sample (adjusted): 2000Q3 2011Q3
Included observations: 45 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ISAL_MI_SA	0.072394	0.033470	2.162940	0.0369
IM2_SA(–1)	0.098671	0.041037	2.404446	0.0212
IDEF_PIB_SA(–1)	0.567638	0.104522	5.430790	0.0000
IR_PIB_SA(–1)	0.256834	0.143842	1.785532	0.0822
R_COST_NESAL_SA	0.003234	0.000712	4.544047	0.0001
DUMMY1	–0.029884	0.015991	–1.868763	0.0694
C	–0.317975	0.152389	–2.086605	0.0437

R-squared	0.848628	Mean dependent var	1.047151
Adjusted R-squared	0.824727	S.D. dependent var	0.036620
S.E. of regression	0.015331	Akaike info criterion	–5.375814
Sum squared resid	0.008932	Schwarz criterion	–5.094777
Log likelihood	127.9558	F-statistic	35.50612
Durbin-Watson stat	2.325977	Prob(F-statistic)	0.000000

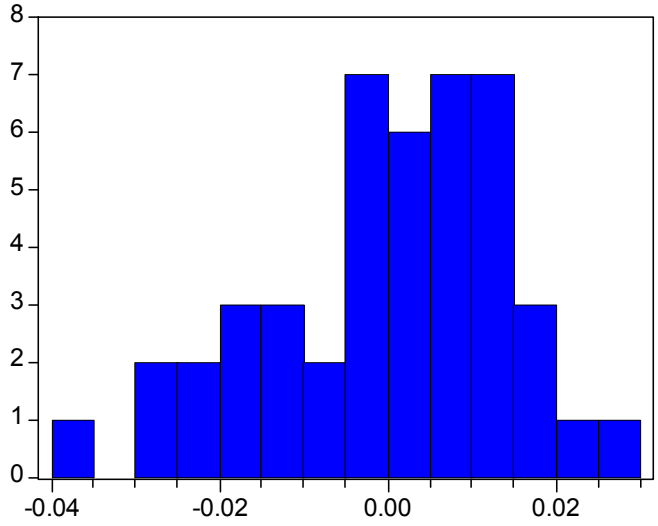
ANNEX 2

Residual Tests
Error autocorrelation Test

Sample: 2000Q3 2011Q3
Included observations: 45

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	–0.125	–0.125	0.7531	0.385
.*| . |	.*| . |	2	–0.145	–0.163	1.7811	0.410
. |*. |	. |*. |	3	0.114	0.076	2.4397	0.486
. |** |	. |** |	4	0.264	0.280	6.0295	0.197
. | . |	. |*. |	5	0.035	0.159	6.0928	0.297
. | . |	. |*. |	6	–0.007	0.096	6.0957	0.413
. | . |	. | . |	7	0.047	0.024	6.2166	0.515
. |** |	. |*. |	8	0.220	0.164	8.9784	0.344
.*| . |	.*| . |	9	–0.097	–0.094	9.5319	0.390
.*| . |	.*| . |	10	–0.078	–0.123	9.9003	0.449
. | . |	.*| . |	11	–0.019	–0.188	9.9231	0.537
. |*. |	.*| . |	12	0.081	–0.095	10.342	0.586
. | . |	.*| . |	13	–0.053	–0.070	10.527	0.650
.*| . |	. | . |	14	–0.080	–0.044	10.968	0.689

Test for normal distribution of errors



Series: Residuals
Sample 2000Q3 2011Q3
Observations 45

Mean	-8.22e-17
Median	0.001511
Maximum	0.026699
Minimum	-0.035454
Std. Dev.	0.014248
Skewness	-0.484575
Kurtosis	2.746847
Jarque-Bera	1.881262
Probability	0.390381

Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.882460	Probability	0.166895
Obs*R-squared	4.260575	Probability	0.118803

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/26/12 Time: 11:27
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ISAL_MI_SA	0.006037	0.033014	0.182852	0.8559
IM2_SA(–1)	0.002233	0.040356	0.055329	0.9562
IDEF_PIB_SA(–1)	0.009734	0.102317	0.095138	0.9247
IR_PIB_SA(–1)	0.052632	0.143207	0.367522	0.7154
R_COST_NESAL_SA	–0.000294	0.000714	–0.411546	0.6831
DUMMY1	–0.004552	0.016214	–0.280759	0.7805
C	–0.041260	0.150565	–0.274035	0.7856
RESID(–1)	–0.257580	0.173370	–1.485723	0.1461
RESID(–2)	–0.259150	0.171324	–1.512628	0.1391

R-squared	0.094679	Mean dependent var	–8.22E-17
Adjusted R-squared	–0.106503	S.D. dependent var	0.014248
S.E. of regression	0.014987	Akaike info criterion	–5.386391
Sum squared resid	0.008086	Schwarz criterion	–5.025058
Log likelihood	130.1938	F-statistic	0.470615
Durbin-Watson stat	2.059369	Prob(F-statistic)	0.868630

White Heteroskedasticity Test

White Heteroskedasticity Test:

F-statistic	0.681512	Probability	0.745645
Obs*R-squared	8.330284	Probability	0.683447

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/26/12 Time: 11:28
Sample: 2000Q3 2011Q3
Included observations: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–0.031325	0.081910	–0.382431	0.7046
ISAL_MI_SA	0.016868	0.009565	1.763601	0.0871
ISAL_MI_SA^2	–0.007413	0.004172	–1.776916	0.0848
IM2_SA(–1)	0.005513	0.010108	0.545422	0.5891
IM2_SA(–1)^2	–0.002611	0.004662	–0.560003	0.5793
IDEF_PIB_SA(–1)	–0.017229	0.074316	–0.231839	0.8181
IDEF_PIB_SA(–1)^2	0.008505	0.035436	0.240010	0.8118
IR_PIB_SA(–1)	0.110617	0.161216	0.686139	0.4974
IR_PIB_SA(–1)^2	–0.056918	0.080811	–0.704335	0.4862
R_COST_NESAL_SA	–0.000511	0.000575	–0.887920	0.3810
R_COST_NESAL_SA^2	2.52E-06	2.77E-06	0.909563	0.3696
DUMMY1	–0.000156	0.000301	–0.516978	0.6086

R-squared	0.185117	Mean dependent var	0.000198
Adjusted R-squared	–0.086510	S.D. dependent var	0.000265
S.E. of regression	0.000277	Akaike info criterion	–13.32529
Sum squared resid	2.52E-06	Schwarz criterion	–12.84352
Log likelihood	311.8191	F-statistic	0.681512
Durbin-Watson stat	2.381655	Prob(F-statistic)	0.745645

ANNEX 3

Stability test

Ramsey RESET Test:

F-statistic	1.027137	Probability	0.368284
Log likelihood ratio	2.497250	Probability	0.286899

Test Equation:
Dependent Variable: ISAL_B_SA
Method: Least Squares
Date: 04/26/12 Time: 11:31
Sample: 2000Q3 2011Q3
Included observations: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ISAL_MI_SA	–9.673870	7.099830	–1.362549	0.1815
IM2_SA(–1)	–13.21055	9.701434	–1.361711	0.1818
IDEF_PIB_SA(–1)	–75.94161	55.75621	–1.362030	0.1817
IR_PIB_SA(–1)	–34.34347	25.23085	–1.361170	0.1819
R_COST_NESAL_SA	–0.432795	0.317773	–1.361963	0.1817
DUMMY1	3.979361	2.924433	1.360729	0.1821
C	90.73801	66.23161	1.370011	0.1792
FITTED^2	125.4274	91.78796	1.366491	0.1803
FITTED^3	–38.83740	28.54525	–1.360556	0.1821

R-squared	0.856799	Mean dependent var	1.047151
Adjusted R-squared	0.824977	S.D. dependent var	0.036620
S.E. of regression	0.015320	Akaike info criterion	–5.342419
Sum squared resid	0.008450	Schwarz criterion	–4.981087
Log likelihood	129.2044	F-statistic	26.92440
Durbin-Watson stat	2.436875	Prob(F-statistic)	0.000000

PLEADING FOR A NEW TAX STRATEGY

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Abstract. *Especially in recent years we witness, not only in Europe, but even worldwide, the worsening of monetary, fiscal and budgetary processes. It's equally true that in the world doesn't exist a perfect system of public governance, and the current tax system is unfair, fragmented and, above all, ineffective.*

The economic imbalances worsening, the prolonged crisis and the slow economic recovery entitle us to rethink the relationship between state's power to tax and the taxpayer's ability and willingness to pay taxes. Given the significant asymmetry of this report, the more active involvement of citizens in the constitution of the state budget resources, and setting limits on government spending and budget deficit would be likely to provide a sustainable insight not only to public finances, but even to the economy as a whole.

Such ideas are increasingly intense promoted by economists and businessmen from many countries, going as far to the introduction in the Constitution of provisions regarding GDP destinations, the introduction or increase of some taxes or the public debt levels. Setting the maximum deficit and debt limits government's power and makes it more responsible in the public resources management. The introduction of these rules in the Basic Law also prevents governments' arbitrary in economic circumstances and changes caused by short-term interests.

Keywords: *economic transmission mechanisms, conditional probabilities, flexible behaviours.*

1. Introduction

The United States of America, a country that has long tolerated an unnaturally high public debt, is now reaching the maximum leverage, which caused it to increase the legal ceiling, in the same old compromises line, in order to avoid the entry into payment incapacity. Not at all surprising, this debt has increased by 72% within only five years, reaching

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a 92% share of GDP, almost equal to that of Portugal. Federal Reserve President[1] from Dallas – Richard Fisher, appreciates that the United States are on the road to insolvency, remains just the answer to when it will occur. And Timothy Geithner, US Treasury Chief, declared that "Our Deficits are too high. They will not be solved by economic growth and, if left unresolved, will affect the pace of development in the future. "And he speaks of the need for a more sustainable budget that would allow the US "to do the essential things".

The situation in the US is a concern for the world community as a whole, in anticipation to some of the FED decisions with implications beyond the boundaries of the country. Other countries, like Greece, Portugal and Ireland are also close to bankruptcy situations, while Spain and Italy also seem to expect it. Budget deficits and public debts have reached huge sizes here, unthinkable a few years ago. Ireland recorded a record budget deficit for the entire euro area, 32.4% of the share in GDP. In the case of Greece the budget deficit was 10.5% in 2010 (13.6% in 2009), and the Government debt of 143% relative to GDP, with growth prospects. The loans, regardless of their source, provide a breath of oxygen but growing indebtedness to unprecedented levels. And images with tens of thousands people marching in the streets of the capital of Greece and other cities, expressing their disapproval with the austerity measures, which have become a fact of daily life, tend to extend dangerously.

The European Union, the European Central Bank and the International Monetary Fund agreed to support these countries and, in the case of Greece, even supplementing aid. Alternative financing costs in the financial markets would be far too large and would increase even further the already excessive debt. The question arising is how effective are these credits and if in fact they only postpone a horrifying denouement, even if they are offered in exchange for the commitment to implement austerity and public finances reform programmes.

The consequences of such situations cannot be only short term. Many analysts believe that the world will sink into a long-term deficit crisis, difficult, if not impossible to manage. Regardless of the actions, more or less concerted of the governments and international financial institutions, which recover what they claim to have learned from previous events and innovates measures in bail-out programs, to require changes in attitudes and corporate behaviour, especially public behaviour. The initiation of

[1] One of the 12 institutions belonging to the EDF.

these programs is the new cornerstone of the crisis treatment. And it doesn't seem to be enough. What needs to become more important is the change in corporate, but especially in public attitudes and behavior. Thus, one can hope that other recessions to find the governments more prepared to react.

2. Romania's tax system

With an open economy, it was impossible for Romania to avoid being affected by what happens abroad. But also it created premises for which generated the same and other imbalances, which overlapped the internal crisis over the imported elements. Since the crisis began in 2008, Romania has doubled its debt to a level of 40% of GDP. If we admit what some standards say about the debt tolerance to the level of 60% of GDP, than the rate at which the debt has increased in recent years should inspire fear. And not only fear but also rethinking of the fiscal strategy. On the other hand, the same three-year period was marked by the adoption of decisions, at least at first sight contrary to the course of economic processes and phenomena, such as introducing a minimum tax[2] charge of bankruptcy or closure of a large number of small and medium companies or increasing the added value tax – recently recognized as an economic and ethical error. The last measure took into account to obtain additional income to the budget, as confirmed in the short term, but the paid price was higher prices and the consumption fall.

The economic imbalances worsening, the prolonged crisis and the slow economic recovery entitle us to rethink the relationship between state's power to tax and the taxpayer's ability and willingness to pay taxes. Given the significant asymmetry of this report, the more active involvement of citizens in the constitution of the state budget resources, and setting limits on government spending and budget deficit would be likely to provide a sustainable insight not only to public finances, but even to the economy as a whole.

Such ideas are increasingly intense promoted by economists and businessmen from many countries, going as far to the introduction in the Constitution of provisions regarding GDP destinations, the introduction or

[2] The minimum tax was introduced in spring of 2009. The Government intended to replace the minimum tax with a flat tax, restricted only to those areas where tax evasion cannot be fought, but the measure was postponed.

increase of some taxes or the public debt levels. Setting the maximum deficit and debt limits government's power and makes it more responsible in the public resources management. The introduction of these rules in the Basic Law also prevents governments' arbitrary in economic circumstances and changes caused by short-term interests.

Currently, in Romania citizens' legislative initiative on tax matters is not possible. Article 74, paragraph 2 of the Constitution states that: "There may not be subject to citizens' legislative initiative the matters concerning taxation, international affairs, amnesty or clemency". In terms of new initiatives such provision would be eliminated and enabled the community consultation on tax issues by the referendum institution.

A working group associated to the H. Rusu Foundation suggests the following phrasing regarding voters' consultation on fiscal issues: "The public administration authorities, central and local, must obtain voters approval in advance, by general or local referendum, for any tax or fee general or local, for the tax rate change, for the extension an expiring tax or fee, and for any other change in fiscal policy which can generate a revenue increase. For the existing general and local taxes at the date of the Constitution's approval, except those that cannot be repealed because they are included in the treaties concluded by Romania with the European Union, should be approved by general or local referendum to be held within maximum of one year from the approval date of the Constitution. General and local taxes that will not be approved by referendum will be repealed in maximum two years from the date of the referendum"[3].

The exercise of the consultation democratic right would be associated with awareness, education and empowerment of the community. The government's power restriction and empowering the citizens in this direction would change, among others, citizens' optics of perpetual government's guilt for the failure of welfare, derived from too much tax. In addition, increase the chances of a fair sharing of the tax burden, based on clear rules and standards shared by the population.

All this and others are truths that have found their first and perhaps the best form in the writings of Adam Smith, economist and philosopher, one of the fathers of economics and classical liberalism:

"*The tax which each person is obligated to pay must be well-defined and not arbitrary. The period of payment, the method of payment, the*

[3] http://www.fundatiahoriarusu.ro/wp-content/uploads/Fundatia-Horia-Rusu-Carta-Responsabilitatii-Fiscale.pdf

payment amount must be clear and obvious, both for taxpayers and any other person. [...] The uncertainty in taxation encourages insolence and favours corruption for a category of people who are so, naturally, unpopular, even when they are neither insolent nor corrupt. Each individual's safety on what to pay is, in terms of taxation, of so much importance that a high degree of injustice, – as you can see, I think, from the experience of all nations, – is a much smaller evil than a lower level of uncertainty.

Any tax should be designed so as to remove and dispose of the pockets of people as little as possible, over as long as the public can bring the state treasury. A tax may either remove of the population's pocket or to remain out of the pockets of the population much more than it brings into the public treasury, in the following four cases: first, its perception may require a large number of officials, whose salaries may absorb most of all taxes and whose gratification may be an added tax to the population.

Second, the tax payers can hamper the economic activity and may discourage them from their occupations in certain business sectors that can ensure the existence and occupation for a large part of the population. [...]

Thirdly, through fines and other penalties which those unfortunate taxpayers bear, trying unsuccessfully to evade the payment, those can often be ruined and thus to end the benefit that the society could get of using these taxpayers' capital. A reckless tax calls for fraud and the fraud penalties are increased in proportion to the tax evasion tendency. The law, contrary to all basic principles of justice, first creates the temptation and then punish those who obey it. [...]

Fourth, the fact that exposes people to the frequent visits and odious research of the tax officials, tax can expose them to completely unnecessary hampering, to insult and oppression;[...] In one or another of these four cases the taxes are often more damaging for the people than profitable for the sovereign"[4].

Fiscal developments in recent years in Romania seem to meet all of a counterproductive tax system features presented by Adam Smith. Romania is a champion in Europe for the number of taxes and charges. The World Bank has identified in Romania nearly 100 taxes that local companies pay, which represents more than in any European Union country. Many taxes

[4] A. Smith, 1992, *Wealth of Nations. Research on the their nature and causes*, Universitas Publishing, Chisinau, 1992, Book IV, pp. 243-244.

regard the labour force and have monthly character. In addition to these requirements, the companies have to pay other 100 fees, the so-called parafiscal charges. As a result, some companies pay about 200 taxes in Romania. The Ministry of Finance estimated that, overall, businesses and individuals taxpayers pay 420 taxes and charges. The present situation is an extreme one if we consider that in Sweden, for example, companies pay only two fees. With more tax liability for taxpayers stands Poland where are perceived about 40 taxes[5].

Much of taxes in Romania generate much higher costs than the revenues to the budget. In strictly economic perspective such taxes should be abolished.

Beyond the reduction in employment and investment motivation, the payment of a large number of taxes causes a high number of hours for tax compliance. From the perspective of the payer, regardless of its quality – natural or legal person – it is a waste of resources leading to either default or delay; either to avoid the payments to the budget. Time wasted in Romania is around 200 hours, which places our country at the top of a ranking on this issue.

The initiative of approving by referendum of the introduction or modification of taxes has been promoted in countries with stable democracy, as the U.S., Switzerland and Finland. In the U.S. there are provisions in a number of states to limit public spending and tax revenues. In Finland an increase in taxes for a period exceeding one year requires a vote in Parliament of two-thirds of its members.

The call for the referendum institution as an instrument of direct democracy in the introduction of certain taxes and charges make possible correlation between "the price" paid by taxpayers for the authorities to provide public goods and services and the benefits derived from their consumption. Such a solution is in the spirit of the vision of Knut Wicksell[6], known as an important predecessor of the public choice school. He claims that the collective action is based on the aggregation of some individual characteristics, as preferences. The individuals are guided by self-interest and rational maximizers of utility, while in political decision are involved reasons regarding voters, politicians and government officials. Wicksell rejects the anthropomorphism and promotes the individualism.

[5] For example, when buying a car are paid registration tax and town hall tax, first registration fee, the fee for the Police numbers, tax for provisional numbers from the dealer, coupon fee and if the car is from domestic production, is paid the card's classification fee to RAR.

[6] Swedish economist (1851-1926).

The state cannot be considered a rational human being who can take decisions on behalf of individuals. Only they are able to support and promote their interests.

Comparing the two types of democracy, direct and representative, it is clear that the size of expenditure, income and public debt is significantly lower in the first case than in the second[7]. In other words, the relationship of Wicksell is present more in direct than in representative democracies. If there is consensus regarding the favourable effect on the economy following a lower level of public debt, when we talk about the expenditures and revenues there is disagreements. A lower level of expenditure is justified by lower income earned on budget, on behalf of lower charges. And if the economic agents give a lower proportion of their income, they are able than to support a range of costs for services which were traditionally financed from the budget. And they can do it better than the state. And the latter requires fewer resources to finance their own programs. If we admit that the level of income and consumption taxation could fall and the public resources would be managed more effectively, then two defining variables can occur in the size of public expenditure, namely the anticipated dynamics in prices and the population dynamics. An interesting calculation formula for revenue and public expenditure was promoted in the U.S. and the legislation in question is known as TABOR. We briefly present this approach and some of the consequences of its application.

The Taxpayer Bill of Rights (TABOR) aimed to limit the power of government in the fiscal area and to correlate the revenue collection for the budget with the inflation and population dynamics. More specifically, it was about their increase in a size equal to the sum of inflation rate and population growth rate. The supporters of the initiative came from among the conservatives and libertarians.

The most famous example of TABOR legislation is the one applied in Colorado since 1993. In this state the voters have amended Article X of the Constitution restricting the central and local revenues. Only the electorate vote allowed both the tax increases and budget revenues spending beyond the dynamics resulting from inflation and population growth. The revenue beyond this limit could be returned to taxpayers or kept but only after a referendum.

Following the adoption of TABOR, a series of proposals to increase taxes at the state level in the 1990's were rejected by referendum. In

[7] Lars P. Feld, Gebhard Kirchgässner, *The Role of Direct Democracy in the European Union*, CESIFO Working Paper No. 1083, February 2003, p. 14.

contrast, other proposals to increase local taxes were approved. Between 1997 and 2001, the state of Colorado reimbursed $ 3.2 billion to the tax-payers, money that could otherwise fund (pre) academic education, public health, public transport, safety and other public services Other important effects produced in the next 10 years were the slowdown of both tax revenue and government expenditure compared to the previous pace of the legislation application, a better correlation between the size of government sector and the demand for public services and the savings rate increasing in personal income with favourable impact on investment and employment.

Subsequently, the spending of public resources was relaxed, at least for education, with the cost of lower funding for other public services. Other restrictions of TABOR were later removed after a new referendum, and the framing in revenues associated to the compliance of the correlation with the prices and population dynamics was still observed.

The Colorado experiment was considered as a confirmation of the positive effects derived from tax cuts. Proponents claim that the intro-duction of this system explained the achievement of a higher level of economic growth registered by the state Colorado than the U.S. In addition, the system ensured the financial independence, being considered as very democratic and transparent.

An interesting fact about promoting TABOR legislation was that it wasn't stipulated any relation to the productivity dynamics and, therefore, the additional revenue derived from increased productivity in terms of a constant population were not taxed and didn't bring any additional income to the budget.

Looking at things from a mathematical and economic point of view, the respect of this formula leads to the reduction in public expenditure in real terms per capita. This decrease can be accepted taking into account the intention of lowering the public spending while increasing the possibility of funding from individuals of previous costs to the State, in the context of the taxation level decreasing.

3. Conclusions

We believe that keeping the public spending in real terms (the strict correlation of nominal spending with inflation) and then increase it with the population index might be a useful formula. In this way the public expenditure per individual remain constant, which may be admitted at least at the start. This does not preclude that when the population decreases to

reduce the public expenditure. As a result, the population variation must be reflected in the absolute level of the public spending and not in the real one.

However, a public spending formula that takes into account the variables mentioned above is preferable to establishing and targeting a fixed percentage who ignores the economic and demographic context and can cause of the worst adverse effects, especially when both inflation and population dynamics are significant. Other advantages of using a formula dependent not only to the variation of economic sizes consist of avoiding the manifestation of political discretionary power, along with the responsibility of the political class. Recognizing that the forecasts regarding economic growth and population evolution are made with enough accuracy, the anticipated and grounded calculation of state's expenditure is another important advantage. Thus the tax system acquires more safety and transparency, virtues often ignored.

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FUNCTIONING OF LOCAL PUBLIC-PRIVATE PARTNERSHIPS (CO-FINANCED BY THE EU FUNDS) UNDER CONDITIONS OF RISK AND TURBULENT ENVIRONMENTS

Wioletta WEREDA*

"Recent years have seen a marked increase in cooperation between the public and private sectors for the development and operation of infrastructure for a wide range of economic activities. Such Public-Private Partnerships (PPP) arrangements were driven by limitations in public funds to cover investments needs but also by efforts to increase the quality and efficiency of public services".

Guy Crauser, Director General, DG Regional Policy, European Commission

Abstract. *Public-private partnership (PPP) is a long-term process which involves the combination of capital, experience, skills in the implementation of public tasks by a private partner, previously accomplished by a public entity. The main goal is to provide a quantitative-quality services standard for the public community in competitive conditions, using innovative instruments, previously unavailable to the public sector[1].*

The aim of this paper is to show the changes in public organizations and economic organizations under conditions of the market economy where the basic economic phenomenon is the competition, risks and the turbulent environment. All these factors drive various entities to seek new ways for organization`s survival by creating their own innovative approach to management based on the example of public-private partnership projects, often in the local area.

Keywords: *public-private partnership, organization, local partnership, cooperation, EU legislation, competition, risk.*

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[1] E. Książek, W. Wereda, *Public-private partnership as an example of innovative management,* in „Współczesne zarządzanie", kwartalnik 2011 – the work has been in the process of publishing.

1. Functioning of partnership in projects co-financed by the European Union Funds

The term of "public-private partnership" comes from the United States where it initially concerned the joint financing of educational programs by the public sector and private one. Wider use of the concept over further years defines the "project or contract" based on the long-term cooperation between a public and private entity, concerning the construction plan, financing and the exploitation of public infrastructure (the object-the building) by a private operator[2].

The possibility of regulating by the bodies of local government units through contracts, the participation of business organizations in the sphere of offering services of public utility[3] is a new form of cooperation for solving problems of the infrastructure shortage, both technical and social one. Therefore, partnerships frequently are established at the local level.

K. Brzozowska divides public-private partnership into "a contract of mandate and contract of specific work" (they do not require the involvement of the private equity partner, they include: contracts for construction, technical supervision, providing services and management contracts), and forms of cooperation involving the capital being related to using that capital during the contract performance, such as leasing agreements, concessions etc.[4]. As a consequence the local partnership requires the involvement of a larger capital to real operating, and therefore entities reach for EU funds to start several joint activities.

PPP is not however an instrument designed solely for purposes of the absorption of EU funds, but its deployment to a wider extent may significantly affect the degree of exploitation of the funds – mostly in strategic areas, such as innovative technologies, technical and social infrastructure and a comprehensive revitalization of cities, regions and other self-government units. Faced with high public deficit and the need for engagement of their own funds in order to finance projects with EU funding, PPP appears to be the best option for beneficiaries. Therefore, whether the chance of raising capital for key investments through PPP and in the future to provide services efficiently, however, depends largely not

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[2] E. R. Yescombe, *Public-Private Partnerships. Principles of Policy and Finance*, Elsevier, Burligtom 2007, pp. 2-3.

[3] W. Misiński, M. Wierzba, *Enterprise relations with local authorities,* in J. Lichtarski (ed.) *Basic sciences about enterprise*, Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław 1999, p. 389.

[4] K. Brzozowska, *Public-private partnerships. Conditions, opportunities, barriers,* Wydawnictwa Fachowe CeDeWu, Warsaw 2006, p. 27.

only on the partners themselves, but also on political and legal considerations in the country[5]. Since 2005 Polish legal regulations have made it possible to partially fund investments in the form of the public-private partnership.

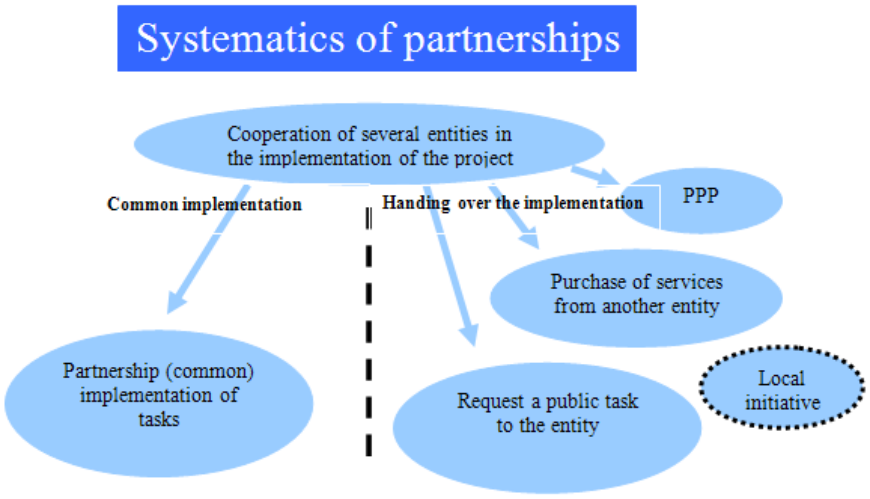

Figure 1. Systematic of partnerships.

Source: Ministry of Regional Development, *Extent of accomplishment of partnership projects specified by the Managing Institution of the Operational Programme Human Capital*, Warsaw 2011, p. 5.

In September 2007 the Operational Programme Human Capital was approved, with a total budget of over Euro 11 billion. The funds are earmarked for the development of human and social capital within the context of accomplishing tasks in relation to the Lisbon Strategy objectives. 65% of the funds will be disbursed by regions and therefore it is of significance to efficiently use them by local communes. The statute of 7 November 2007 on amending some laws with regard to implementation of structural funds and Cohesion Fund (new Art. 28a in the law on principles on pursuing the development policy)[6] lays out rules for establishing partnerships by a managing institution. Pursuant to the agreement partnerships may be set up by entities contributing human, organizational, technical, or financial resources which jointly accomplish the project on the conditions specified in the agreements or the partnership agreement. A partnership project is accomplished under the decision or subsidy agreement concluded with a beneficiary acting in the name and on

[5] http://www.doradca-ue.pl (access date: 2010.05.28).

[6] Law on principles for pursuing the development policy of 6 December 2006, Art. 28a, Dz. U. No. 216, item 1370 as amended.

behalf of partners to the extent specified in the agreements or partnership agreement, which specifically sets out partners' tasks, rules for joint managing the project and the manner for transferring the financial resources by the beneficiary to pay costs incurred by partners to complete their assignments under the project.

2. Barriers for local partnerships

Local partnerships when being established run into numerous barriers, even on the side of local authorities. Often, it is a lack of potential, sometimes local authorities are anxious to lose their sway, perceiving the partnership as a threat to their supremacy. A lack of potential also presents a hindrance to effective involvement in partnership for non-governmental organizations which experience problems in representing the sector on a broader field. Whereas private companies though diminished confidence towards local authorities and focus on conducting their own business, constitute a sector which enhances employment rate as well as economic growth. They are a driving force behind local and regional economies; therefore the emphasis should be placed on winning their representatives for the concept of partnership. Other sectors should reinforce and create conditions for advancement of the private sector, to build the atmosphere of confidence and mutual understanding. The knowledge of legal provisions that govern rules for inter-sectoral partnership, and opportunities provided by partnership is still marginal. It is evidenced by the small number of investment initiatives carried out in the form of PPP. There are virtually no completed investments on the basis on this formula as demonstrated by research conducted in podlaskie voivodeship as well as in Poland at large. The reasons behind this plight may be traced to the drawbacks of the PPP law of 2005, applicable until recently. The new law that entered into force in February 2009 corrects numerous flaws. Promoting inter-sectoral partnership is particularly vital in poorer regions as e.g. podlaskie voivodeship because the local governments usually do not have sufficient funds to be able to individually accomplish big public investments such as sport buildings, schools, hospitals, etc.

The key drivers impeding and obstructing partnership cooperation are as follows:

- Lack of cooperation and lack of need for inter-sectoral cooperation,
- Focus on performing present statutory activities,
- Fragmentary actions taken,

- Lack of sufficient technical and logistic background,
- Lack of qualified personnel,
- Relations "contractor – principal" instead of partnership relations,
- Involvement in operations as a sub-contractor, not a partner,
- "bureaucratic" approach of public bodies,
- "demanding" attitude of social organizations[7].

3. Benefits offered by local partnership

Cooperation initiated within PPP delivers a range of benefits, the major ones include:

- Enhancing capital stream to be allocated for investments in public services by the way of winning private capital – PPP system enables to complete projects with limited availability of public capital as the essence of PPP is its capacity for acquiring funds from a private sector – private capital replaces public resources. Also, it is essential in view of necessity to mobilize financial capability of Poland in winning EU structural funds;
- Gaining knowledge and experience of the private sector and thus boosting capacity and quality in the domain of public tasks performed;
- Better risk allocation within the venture accomplished – within PPP the specified risk is imposed on a party which enjoys biggest capabilities for successful managing it on specific costs. The objective should be optimization of risk to ensure the largest added value possible and not maximization of its transfer and its disposal;
- Enhanced efficiency in exploitation of resources and better quality of services – as the record shows, within PPP a wide range of activities may be undertaken more efficiently when applying management discipline and competences of the private sector, and then the level of services rendered within PPP often surpasses those rendered in a traditional manner, which results from a superior organization, oversight and use of innovative solutions, and drive to reduce costs. Importantly, this drive is fuelled by the interest of private capital, that is profiting from benefits as well as

[7] Ministerstwo Pracy i Polityki Społecznej, Departament Rynku Pracy, *Through the cooperation to the success. Local partnership in the labor market* (ed.) A. Sobolewski, R. Krzewicka, G. Och, J. Olszowska-Urban, J. Piekutowski, G. Podławiak, T. Sobolewski, Warsaw 2007, p. 49.

gaining public oversight, i.e. PPP agreements regarding consequences of failure to satisfy standards and quality of services rendered by a private partner;

- Possibility to generate added revenues from third parties within the project which diminishes the need to involve public resources;
- Ensuring optimal management of the venture coupled with reducing its total costs – imposing risk with regard to accomplishing the project on a private partner serves as an incentive to searching for optimal managing methods and implementing given projects which then translates into optimal disbursement of funds being at disposal of a private partner and thus decrease in total costs with the cycle of the project. Also, it should be kept in mind that reduction of total costs cannot affect the standard and quality of services provided and other norms specified in the agreement on PPP as the remuneration of a private partner is subject to their meeting;
- Strengthening the managing role of the public sector – through shifting responsibility for completion of the project to a private partner (it should be kept in mind that competence and accountability for completion of assigned tasks remain to be within the scope of the public sector), the public party will focus on regulatory functions, planning and monitoring the process of accomplishing projects aimed at completing public tasks; moreover, fostering competitiveness of public services make them market oriented and therefore maximize the value of invested resources in the project[8].

4. Functioning of local partnerships under conditions of risk and turbulent environment

Enterprises operating in the present day must confront increasing competition, environmental variability, continuously re-configuring requirements and consumers' tastes. The ever changing environment induces them to take actions not only in the real world, but also to delve into the hyper-reality, and to function on many levels of the culture. Contemporary culture is often labelled by cultural sociologists as 'instant', and portrayed by the means of the maxim – "fast food, fast sex, fast car", and dominated

[8] Based on European Commission Publication, *Guidelines for Successful Public-Private Partnerships*, Brussels 2003.

by the volatility, speed and media[9]. The emergence of the global consumer and accompanying phenomena such as, the global teenager of generations *X* and *Y* with transparent and unstable identities and indifferent to traditional values, poses new challenges but also provides opportunities for companies operating in the market. The maxim "innovative or die" seems to fit here – emphasizing the need for constant changes in the course of gaining a competitive advantage. Therefore, it is not surprising that enterprises are looking for permanent values as the foundation on which they may build its competitive advantage[10], such as innovations, positive image, partnerships and the cooperation with stakeholders.

Markets in turbulent environments are usually emergent (no clear dominant design, no stable business models, no clear boundaries between or within an industry and no clear competition), and transformational – new technological breakthroughs and shifts in regulation[11]. Industrial economists or planners do not have the time to gather the necessary data, let alone analyze it, to find a position to go after or engineer a fit between a shifting organization and a turbulent environment[12]. In such environments change happens on different levels and with different impacts.

We can consider two issues in the functioning of organizations: turbulent environments and environment turbulence. From the general opinion these two terms are interpenetrating[13].

According to the web dictionaries "environmental turbulence refers to the amount of change and complexity in the environment of a company. The greater the amount of change in environmental factors, such as technology and governmental regulations, and/or the greater the number of environmental factors that must be considered, the higher the level of environmental turbulence. For many reasons environmental volatility and instability have been increasing for the past 100 years"[14].

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[9] B. Siemieniecki, *Media Pedagogy. Academic Handbook,* Vol. 1, PWN, Warsaw 2007, pp. 111-115.

[10] W. Wereda, T. Zaclona, *Creation of trade brand images in a turbulent business environment based on the example of social portals*, UMCS, Lublin 2011 – the work has been in the process of publishing.

[11] S. Brown, K. Eisenhardt, *Competing on the Edge: Strategy as Structured Chaos*, Harvard Business School Press, 1998.

[12] Using systems thinking, we can clearly see that finding a fit between an organization and its environment is an almost impossible task. Every move an organization engages in, to maximize its fit, perturbs its environment instantly modifying the fit value. The quest for fit maximization becomes another source of change in the system.

[13] W. Wereda, T. Zaclona, *Creation of trade brand images in a turbulent business environment based on the example of social portals*, UMCS, Lublin 2011

[14] http://planningskills.com/glossary/30.php (access date: 20.07.2011).

For instance, Ansoff introduces the concept of environmental turbulence to describe the different environments. He classifies the different environments in which organizations operate into five distinct turbulence levels. At one extreme is the stable, placid environment where nothing changes; at the other is the creative environment, characterized by major technological breakthrough, and social political upheavals[15]. That is why all organizations functioning in the turbulent environments have to face different types of risk.

If we talk about the risk concerning public-private partnership, it can be described as any factor, event or influence that threatens the successful completion of a project in terms of time, cost or quality. A key principle of PPPs is that risk should be allocated to the party best able to manage it. The effective allocation of risk has a direct financial impact on the project as it will result in lower overall project costs and will therefore provide enhanced value for money if compared to traditional procurement methods. The direct relationship between risk and financial impact lies also in the fact that the degree of risk transfer to the private sector will influence the overall cost of the project to the public sector as all risk will be associated with a price premium.

Therefore the objective must be to achieve cost effective risk transfer not simply risk allocation for its own sake. The objectives of risk transfer include:

- To reduce long term cost of a project by allocating risk to the party best able to manage it in a most cost effective manner;
- To provide incentives to the contractor to deliver projects on time, to required standard and within the budget;
- To improve the quality of service and increase revenue through more efficient operation;
- To provide a more consistent and predictable profile of expenditure[16].

The risk categories which have been seen in the process of initiations of PPP include: revenue risk, choice of private sector partner, construction

[15] S. Seng Pun, *MANAGING IN TURBULENT ENVIRONMENTS. Igor Ansoff's Strategic Success Model* in "FEATURE – Management News" issued by Singapore Institute of Management, PDF format (dated on 20.07.2011).

[16] European Commission Publication, *Guidelines for Successful Public-Private Partnerships*, Brussel, 2003, pp. 52-53.

risk, foreign exchange risk, regulatory/contractual risk, political risk, environmental/archaeological risk, latent defect risk, public acceptance risk, sustainability risk, hidden protectionism[17].

Revenue risk is the most fundamental of all unknown factors involved in PPP projects. Revenues flows are generally determined by two factors: utilization levels, and tariffs. The availability of reliable historic information documenting demand and price elasticity levels varies among different sectors[18].

Another type is the risk of choosing of private sector partner. Thus, inherent risk is associated with forming a partnership with unknown partners. This is accentuated through a public procurement process which does not facilitate extended negotiation periods allowing a degree of knowledge and confidence to be established. The principle risks are that the private party proves insufficiently competent and/or is not able to deliver the services to the initial specifications. This can be because of a badly researched tender or because tenders were designed to win the contract in the hope of recovering costs at a later stage. In both instances the tender evaluation must aim to identify such situations[19].

The third risk is connected with construction costs. The capital construction cost of any project is one of the fundamental factors upon which financing is based, and when cost overruns are incurred, the financial feasibility of a concession can be jeopardized. Poor project definition, unknown geological conditions, or loosely defined safety specifications can have dramatic affects on capital construction costs. However, these potential problems can be mitigated with the completion of careful engineering studies before a concession contract is actually signed. Construction delays also have detrimental effects on capital costs. While some delays can be minimized through careful construction management, they still have the potential to arise. Other external factors, such as timely delivery of right-of-way, for example, are more difficult to manage. External forces such as inflation, economic policy, embargoes, and political conflicts also have the potential to have dramatic affects on capital costs. Construction risk is nearly always assigned to the private party, which in turn is likely to include strong incentives for on-time completion of works in its construction contract[20].

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[17] Based on *Ibidem*, pp. 53-56.
[18] *Ibidem*, p. 53.
[19] *Ibidem*, p. 54.
[20] *Ibidem.*

This risk can be exacerbated when governments require that concessionaires obtain a certain portion of their financing from foreign sources. Foreign exchange risk is greatest when weak currencies are involved, putting projects in emerging economies at greater risk. In certain cases, foreign currency risk can be assumed by sovereign governments, export credit agencies, or international financial institutions in order to make concession projects more attractive to private investors[21].

The fifth type of risk is the regulatory/contractual one. Although governments negotiate contract terms and conditions with their concessionaires, they are not always successful in maintaining their commitments. This is particularly true of tolls and other user fees, which tend to be politically sensitive. These risks are more common than many project finance proponents like to admit. They can have substantial effects on existing concession agreements, and also weaken interest in future projects. Regulatory risk is exacerbated in countries where new and untested laws govern PPP projects. Such risks can be expected to be greatest in countries with comparatively little experience in project finance[22].

Another very important type of risk is the political one. Assessments of the inherent strength and stability of local political institutions are common in the investment field and are reflected in bond ratings prepared by internationally recognized rating agencies. As political risk increases, so does the cost of obtaining financing. The long duration of most concession agreements and the common aversion to user fee increases, make PPP projects especially susceptible to political risk. This is exacerbated when new governments oversee unpopular projects instigated by previous administrations. Political risks are often assumed by host governments, but such an assignment can prove less than optimal in the face of lacklustre political support for an infrastructure partnership[23].

Infrastructure projects have the potential to provoke environmental concern, and governments and citizen groups are becoming increasingly vigilant in their efforts to mitigate potential impacts. Unforeseen environmental issues can increase capital costs considerably and result in serious delays. Environmental risk is usually assumed by the private party. For this reasons, most would-be investors undertake thorough environmental assessments and identify likely mitigation programs before entering into a concession agreement[24].

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[21] *Ibidem.*
[22] *Ibidem*, pp. 54-55.
[23] *Ibidem*, p. 55.
[24] *Ibidem.*

Coming to the eighth type of risk – a latent defect risk, it is now increasingly common for governments to provide contractors/concessionaires with the right to pre-existing infrastructure systems as a way to help finance the construction of new infrastructure. In many cases, new projects may also involve upgrading and expanding existing systems. In exchange, concessionaires usually assume responsibility for the maintenance of these facilities for the duration of their contracts. While seemingly attractive, this mechanism can be costly for concessionaires if the facilities they inherit have unknown structural faults. The risk of encountering unpleasant surprises can be minimized when thorough and well-documented inspections of the facilities to be transferred are completed before concession contracts are formalized[25].

Infrastructure projects have the potential to provoke vociferous protests among local communities; a fact which can prove fatal to private concessions. There are several notable examples of public acceptance risk in Europe. Many experiences in different areas demonstrate the very real threat that public acceptance risk can pose. Prudent investors need to make careful assessments of the approvals required for their projects, as well as public sentiment towards the projects before deciding to invest[26].

The next type of risk, especially connected with local partnerships, is the sustainability risk. A principle objective of the public sector is to protect the public interest and ensure delivery of value for money. Publicly procured and operated projects provide the tax paying public with the ability to control the quality through votes and taxes. The introduction of private operators may reduce this control if effective control or oversight systems are not developed. Along with the development of an effective public sector management and monitoring capability it is necessary to promote the development of consumer "watchdog" associations and allow for public consultation. This not only creates a direct link with the private operator but also develops a strong sense of consumer ownership or participation in PPP projects[27].

The last type of risk which can still be seen sometimes in different countries is hidden protectionism. Infrastructure provision is generally perceived to be within the domain of the public sector, and the public can be sceptical when private actors are involved. Such scepticism can be exacerbated when investors are from an outside and more affluent country

[25] *Ibidem*, p. 56.
[26] *Ibidem*.
[27] *Ibidem*.

and have the potential to make a profit on their investment. When such a reaction occurs among the populace, it can also have repercussions in the political arena, making it more difficult for foreign investors and their host governments to resolve conflicts. Foreign investors would be negligent if they ignored this issue, and should investigate the experiences of other outside investors in the countries where they are considering doing business. This risk is borne by the concessionaire and it is best countered by consistent government support. It is however ironic to note the often inconsistent approach of public bodies to foreign participation. Particularly there is often less objection to arrangements developed through direct agreements than when public procurement is involved. It is through the latter that nationality and foreign participation most often becomes an issue[28].

Table 1.
Advantages and Disadvantages of PPP Relationships

PPP Type	Main Features	Application	Strengths	Weaknesses
Contracting	• Contract with Private party to design & build public facility • Facility is financed & owned by public sector • Key driver is the transfer of design and construction risk.	• Suited to capital projects with small operating requirement. • Suited to capital projects where the public sector wishes to retain operating responsibility.	• Transfer of design and construction risk. • Potential to accelerate construction programme.	• Possible conflict between planning and environmental considerations. • May increase operational risk. • Commissioning stage is critical. • Limited incentive for whole life costing approach to design. • Does not attract private finance
BOT	• Contract with a private sector contractor to design, build and operate a public facility for a defined period, after which the facility is handed back to the public sector. • The facility is financed by the public sector and remains in public ownership throughout the contract. • Key driver is the transfer of operating risk in addition to design and construction risk.	• Suited to projects that involve a significant operating content. • Particularly suited to water and waste projects.	• Transfer of design, construction and operating risk • Potential to accelerate construction • Risk transfer provides incentive for adoption of whole life costing approach • Promotes private sector innovation and improved value for money. • Improved quality of operation and maintenance. • Contracts can be holistic • Government able to focus on core public sector responsibilities.	• Possible conflict between planning and environmental considerations. • Contracts are more complex and tendering process can take longer • Contract management and performance monitoring systems required. • Cost of re-entering the business if operator proves unsatisfactory. • Does not attract private finance and commits public sector to providing long term finance.
DBFO	• Contract with a private party to design, build, operate and finance a facility for defined period, after which the facility reverts to the public sector. • The facility is owned by the private sector for the contract period and it recovers costs through public subvention. • Key driver is the utilisation of private finance and transfer of design, construction & operating risk. • Variant forms involve different combinations of the principle responsibilities.	• Suited to projects that involve a significant operating content. • Particularly suited to roads, water and waste projects.	• As for BOT plus: • Attracts private sector finance; • Attracts debt finance discipline; • Delivers more predictable and consistent cost profile; • Greater potential for accelerated construction programme; and • Increased risk transfer provides greater incentive for private sector contractor to adopt a whole life costing approach to design.	• Possible conflict between planning and environmental considerations. • Contracts can be more complex and tendering process can take longer than for BOT. • Contract management and performance monitoring systems required. • Cost of re-entering the business if operator proves unsatisfactory. • Funding guarantees may be required. • Change management system required.
Concession	• As for DBFO except private party recovers costs from user charges. • Key driver is the *Polluter Pays Principle* and utilising private finance and transferring design, construction and operating risk.	• Suited to projects that provide an opportunity for the introduction of user charging. • Particularly suited to roads, water (non-domestic) and waste projects.	• As for DBFO plus: • Facilitates implementation of the *Polluter Pays Principle*; and • Increases level of demand risk transfer and encourages generation of third party revenue.	• As for DBFO plus: • May not be politically acceptable • Requires effective management of alternatives / substitutes, eg alternative transport routes; alternative waste disposal options)

[28] *Ibidem*, See more: B. Domańska-Szaruga, W. Wereda, *Management under conditions of risk and uncertainty*, Publishing Company EMKA, Warsaw 2011.

Explanation:

BOT – Integrated partnerships involve transferring responsibility for the design, construction, and operation of a single facility or group of assets to a private sector partner. This project delivery approach is practiced by several governments around the world and is known by a number of different names, including "turnkey" procurement and the "build-operate-transfer" (BOT) system.

DBFO – The primary vehicle for PPP opportunities involving direct private sector investment is the design-build-finance-operate (DBFO) concession agreement. These agreements enable a private investment partner to finance, construct, and operate revenue generating infrastructure improvement in exchange for the right to collect the associated revenues for a specified period of time. Concessions can be awarded for the construction of a new asset or for the modernization, upgrade, or expansion of an existing facility.

Source: European Commission Publication, *Guidelines for Successful Public-Private Partnerships*, Brussels 2003, p. 28.

As table 1 show there are always advantages and disadvantages of the four main groupings of PPP relationships. It also provides suggested sectoral applications. The selection of a suitable PPP arrangement is a complex task and must be based on individual project characteristics and needs. It is very important to define different pros and cons of PPP relationships to see or recognize future threads and risks of the private and public cooperation.

5. Conclusions

Inadequacy of financial resources for the implementation of public tasks, the dissatisfaction of local communities, the development of techniques and technologies associated with the production and delivery of public goods and services[29] compel local government authorities to drive changes in creating conditions and opportunities for deploying management methods and techniques in the public sector, that are applied in the private sector. Qualitative-quantitative changes should trigger a positive indicator *Value for Money* to a public entity whereas a competitive rate of return from invested resources in PPP projects [30] to a private partner.

[29] K. Mataśka, *The nature and extent of public-private partnerships in Poland* in J. Rutkowski (ed.) *Public-Private Partnership in Poland and its operation on the example of selected projects,* Publisher University of Lodz, Lodz 2010, p. 22.

[30] E. Książek, W. Wereda, *Public-private partnerships as …, op. cit.*

Therefore, the essential aspect of the functioning of local partnerships is cooperation of both partners and recognition of mutual benefits. Unfortunately, the risks inherent in such initiatives and turbulent environments often hinder local government units` managing staff and entrepreneurs to initiate such organizational and financial innovations in management of various local projects. Therefore, it is reasonable to initially discern the environment and prior identify a range of risk types that accompanies local public-private partnership.

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APPLICATION OF THE INFORMATION TECHNOLOGY IN THE CUSTOMER RELATIONSHIP MANAGEMENT

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Abstract. *It is the information management, including knowledge management that is the essence of functioning of any modern company operating in the new economy. Thanks to teleinformatic technologies, information and knowledge becomes the primary engine of the economic development, as well as the decisive criterion determining the business success or failure of units, companies, regions and total economies.*

It is in the article that the issue of applying the information technology in managing relationships with customers, who are more demanding and expect the personal touch from sellers in conditions of the market of the buyer, was raised. For the reason, the enterprises use modern technologies in the customer relationship management, which are applied to intensify contacts with customers and to keep relations being based on interaction with them, what may result in maximizing the number and the value of transactions. Much space is devoted to Customer Relationship Management (CRM) – the idea of customer relationship management is characterized by a high degree of individualization of the approach towards the buyer of goods and services, increasing his satisfaction as well as building his loyalty. The special attention was paid to the technological side of the CRM concept, because it is IT that becomes a platform constituting the foundation for it. However the possibility of applying modern technologies in managing relations with customers does not mean that every company must introduce such systems. Therefore, much space was devoted to planning the CRM system and to the process of the selection of the CRM tools.

Keywords*: information management, knowledge management, customer relationship management*

1. Introduction

The changeability of the business world, particularly the development of information technologies and the Internet, forces modern enterprises to seek new management methods and techniques. It is the information

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management, including the knowledge management that is the essence of the functioning of a modern company in the new economy. It is possible to distinguish even certain basic features of this new paradigm, which the world economy enters. These are: the computerization, the globalization, the networking of everything and everyone, the sovereignty of customers and the key role of knowledge. Such terms as teleworking, portal, globalization, network effect, e-commerce and virtual corporation permanently entered the dictionary of the business world and they were created in order to describe this new business environment.

Thanks to the computer technology (IT), the enterprise operates in "cyber space", where the time of the information transfer and the process of decision-making are very short. The application of the computer technology (IT) in business activities supports and increases efficiency of enterprises. It is achieved by hastening management procedures, improving the quality of numerous operations and it enables handling larger information resources. These are the information technologies that constitute the skeleton of the new economy.

The new economy describes the new business environment, in which the information and the knowledge, thanks to teleinformatic technologies, become the primary engine of the economic development, as well as the decisive criterion determining the business success or failure of units, companies, regions and total economies. The information and the knowledge create the value added, increase productivity and economic efficiency. It is currently that the most important factor in this game is the Internet. Each technology is associated with certain determinants and possibilities. Internet technologies and its applications open new opportunities of interaction between consumers, companies and trade partners[2].

It is in the article that the issue of the application of the information technology in managing relationships with customers, who are more demanding and expect the personal touch from sellers, was raised. It is in a customer service department that a value for any company is created, which is the determinant of the effectiveness of operating. Therefore, companies abandon mass marketing and rely on concepts of individualized marketing. The change consisting in applying the information technology in the process of the customer service and developing relations with him is a very important component. CRM (Customer Relationship Management) Systems are the examples, which enable the interactive communication with any customer and building relations with him.

[2] http://www.modernmarketing.pl/index.php?pg=ene (28.06.2011)

2. Customer Relationship Management (CRM)

As a result of the global competition on the market, companies seek innovative solutions supporting by the determination of customer needs. Thanks to the detailed information, decisions are more accurate. It is CRM that is the indispensable tool for such activities and is the management system for cooperation with customers. This system is a set of activities designed to identify the most valuable customers and the ways of keeping them in the company, as well as to increase the number of transactions with them. CRM is therefore a method for a permanent contact with customers, and consequently for increasing profits of the enterprise.

The concept of CRM is a response to amendments, which have been occurring on the market since the early eighties. These changes include among other things: an increase in global competition, decline in customer loyalty, increasing costs of acquiring new customers, increasing experience and requirements of customers towards suppliers, reduced effects of promotional activities but first of all the appearance of multimedia technologies and the Internet.

It is hard to explicitly define the CRM, both because of its scope as well as arising alterations. It seems to be the most concise and accurate formulation that CRM consists in the mutual adaptation of the customers and companies, being aimed at building the long-lasting, partner relation "the company – the customer"[3]. The CRM, as a customer oriented business strategy, integrates marketing, promotion, sale as well as service and supporting processes; aims at transforming contacts with customers (earlier limited only to the sale and the shopping) into the long-term partnership, being based on interaction[4]. It is an amendment to the philosophy of the company aiming at having and dealing with loyal customers rather than with "indifferent buyers", originating from the relationship marketing.

According to the Wioletta Wereda`s customer relationship management concept, CRM is the long-run process of first – gaining clients and then – keeping them by a company. If the company wants to achieve the success in implementing the CRM strategy, the process should consist of such elements as: values for the customer, high quality of products/ services, proper communication with the customer, segmentation and purposeful selection, personal promotion tools, personal employees' policy

[3] See: K. Storbacka, J. Lehtinen, *Art of building lasting relationships with customers. CRM,* ABC, Krakow 2001, pp. 17-20.

[4] M. Capiga, *The capital of the bank customer.Selected aspects of management and evaluation*, Twigger, Warsaw 2005, p. 62.

and internal marketing, special loyalty programmes, partnership relations with a competition[5].

The definitions cited above refer to CRM in the business meaning. Another approach – IT approach, considers CRM as software with wide telecommunications and telemarketing abilities from the group "front office". It is from the point of view of the enterprise that the most important aim of CRM is to maximize the number and values of transactions per 1 customer (what has always been an aim of marketing and all sale operations) by developing the relation "the customer – the organization".

In the field of CRM systems, there are distinguished three kinds of them[6]:

- operating CRM;
- analytical CRM;
- interactive CRM.

The difference between them consists in tactics applied by the organization, while implementing the concept.

The operating CRM is a concept orientated towards capturing and gathering information on activity of customers on all levels of the cooperation. It applies both to basic contacts with sales representatives, visits in company shops and salons, phone calls, visits on websites, as well as to inquiries or contacts resulting from trade negotiations. The operating CRM integrates functions of marketing and customer services in it ensuring the personal touch to each of customers and the full knowledge about their needs. It enables the registration and the analysis of all events with customers.

The analytical CRM is focused on the analysis of the data collected by other systems functioning in the enterprise i.e. sales, supply or logistics systems. It allows to identify customer preferences and behaviours, trends in sales at various intervals, groups of contracting parties, of goods as well as to analyse systematically best-selling products. Moreover, it identifies the best customers and employees. Thus, it enables to create proper offers, examine their good and weak elements in order to increase profits and to minimize costs. The analytical CRM accomplishes the following functions[7]:

- inspecting the marketing base of customers;
- analysing the effectiveness of marketing-commercial actions and of the sale;

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[5] W. Wereda, *Customer Relationship Management (CRM) and the behaviour of buyers in the services market,* Difin, Warsaw 2009, p. 187.

[6] A. Mazur, K. Jaworska, D. Mazur, *CRM Customer Relationship Management,* MADAR, Zabrze 2001, pp. 21-22.

[7] J. Wachnicki, P. Komornicki, *Analytical CRM,* „Modern Marketing", nr. 02/2002.

- analysing the effectiveness of web pages;
- obtaining the information on visits on web pages.

The interactive CRM (is called cooperative or contact CRM). It is a communications centre, a network coordinating contact channels with customers, suppliers and business partners. It can be a portal, PRM application (Partner Relationship Management), a centre of interaction with the customer – CIC (Customer Interaction Centre). The means of communication applied are: a phone, an SMS, a Web page, an e-mail, a fax, voice applications or even a traditional mail. It is used mainly in service departments at a technical assistance, sales and marketing departments. The combination of all CRM systems mentioned above in one gives us an integrated system. It combines all functionalities, by what it provides the comprehensive realization of needs of the company in creating positive contacts with customers. One should however mention that developing a CRM strategy is an individual matter of each company, since the fully integrated system does not have to be the optimal solution. The architecture of an integrated CRM system was presented in the figure 6. The fundamental difference between individual types of the CRM concept is that the operating CRM facilitates the access to the information about the customer, however the analytical one allows for analysis of this information by providing the access to the customer preferences and habits. Such knowledge can be used in processes of the decision making in relation to the customer relationship management.

However CRM is not only a computer system, it is a strategy, a philosophy of operating of a company, which is aimed at improving and intensifying contacts with customers and thus at a rapid growth measured by an increase in the company value. It is for the purpose that the software facilitating achieving assumed purposes is used. It is possible to hazard a guess that CRM tools are currently the basis for the implementation of the strategy of increasing the sales efficiency. A professional, modern CRM application effectively supports all contact areas with customers, as well as information exchange inside the company. The support includes individual elements of activity of the company[8]:

- sales (administering customer accounts, all events associated with customers);
- marketing (marketing campaigns, distribution lists, e-mails and phones);

[8] A. Stachowicz-Stanusch, M. Stanusch, *CRM Guide for implementing staff,* Placet Publishing Agency, Warszawa 2007, p. 94.

- customer service (call centre, contracts, customer complaints);
- workflow (calendars, tasks, holidays, HR, knowledge base, version management and document flow, project management);
- managing contracting parties (enables collecting of such information as: teleaddress data, the segmentation and profiles of customers);
- Reporting (thanks to it, it is possible to analyse he various spheres of the customer relationship management and to examine the work efficiency of persons responsible).

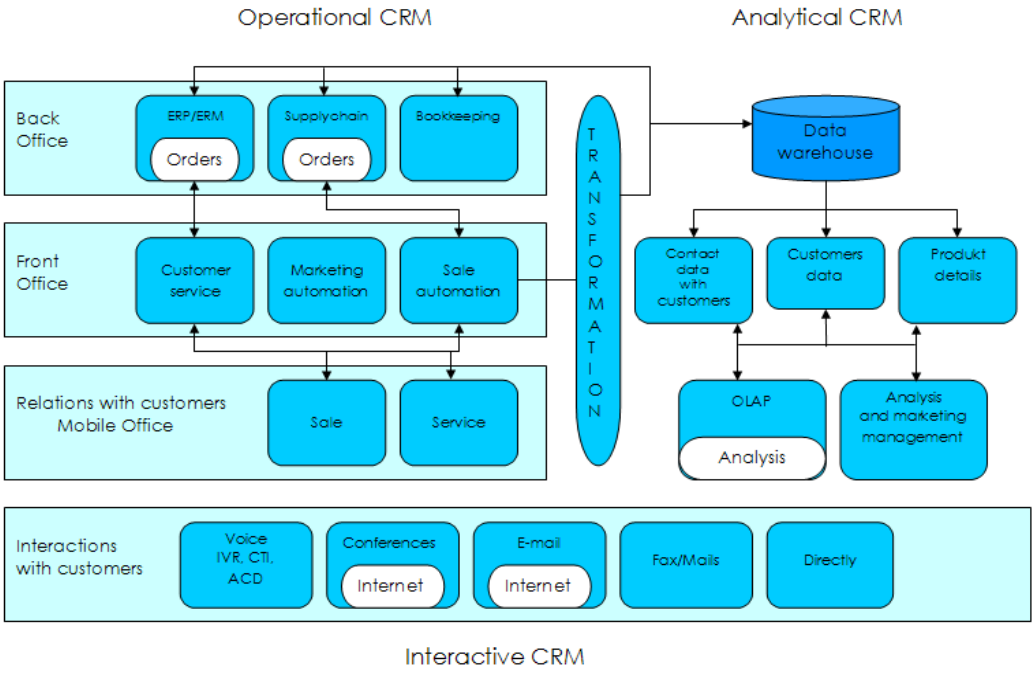

Figure 1. CRM architecture.

Source: A. Mazur, K. Jaworska, D. Mazur, *CRM Zarządzanie kontaktami z klientami [CRM Customer Relationship Management],* Madar, Zabrze, p. 23.

In big and developed CRM systems, its functions are most often in separated modules. Due to the diversified approach towards the issue of CRM, individual producers of computer applications create the architecture of the software in different ways. It is possible, however, to mention the modules, which are designed by the majority of producers[9]:

[9] A. Stachowicz-Stanusch, M. Stanusch, *CRM Guide for implementing staff,* Placet Publishing Agency, Warszawa 2007, pp. 94-106.

1. Account Management (managing contracting parties). It is the module, which stores the information associated with customers, contracting parties and sometimes with competition. It is called a Customer Charter most often. The function of customer data allows collecting information on: the teleaddress data, the activity sector, the industry, the region, turnovers, the organizational structure as well as on who is responsible for contacts with the given customer. Furthermore, there is an easy access to the history of accounts with the contracting party, invoices, obtaining information about sale conditions, the amount of the merchant credit, and the like

2. Contact Management (managing contacts). This module collects the data about employees of companies, with which the interaction appears. It enables to enter such information as: the full name, the position, the place in the organizational structure, the teleaddress data and the level of discretion. The history of contacts allows for displaying the date, the hour, the matter subject of all contacts, which occurred with the given employee. Simultaneously, it is possible to get reports on relations, which connect employees of individual companies.

3. Sales Management (sales management). It enables to define the sales cycle depending on the product, type of the customer and the like CRM Systems facilitate the registration of all contacts with contracting parties at each stage of the sales cycle, which in particular consists of accepting of an inquiry, negotiations, detailed arrangements and contract itself.

4. Time Management Tools (time management). The calendar function displays the list of scheduled meetings, events and activities to be carried out within specified period. Besides, it assigns tasks to the specific person and gives them priority. The alarm function is aimed at reminding the approaching deadline for the task or passing time of the meeting.

5. Customer Service (managing the service). This function collects the information on service notifications. It is in CRM systems that the data on the user of the product, damaged elements, the preliminary diagnosis, the configuration and the place of the user are collected. It also enables registering service contracts and benefits associated with repair. Furthermore, there is a constant access to tracking the progress in the accomplishment of the customer complaint. It is reporting all service events that is also essential for analysing, i.e. statistics of repairs and damages.

6. Telemarketing. The module allows for creating lists of companies and persons that will be subject to telemarketing through choice based on specific criteria. The system automatically dials the numbers to customers

from the earlier created list. It contains features enabling the construction of the base of outgoing calls and features of automatic selection of numbers from the determined database, registrations of talks and keeping their statistics. Additionally, there is a possibility of managing price lists, marketing campaigns (budgeting, accounting for campaigns, conducting direct actions).

7. Marketing. This function collects the information on: the name, the model and series, the technical specification and prices as well as photographs. The advanced CRM systems allow conducting customer-specific price lists, to archive previous prices and the ways of allocating discounts. This module facilitates entering essential data into the campaign (the target market, targets, applied promotion measures and its plan). Settlement of campaigns carried out allows creating their history. On the basis of the data from previous campaigns, the system helps to determine, which promotion and advertising measures are most effective in order to achieve a large turnover.

8. Partner Relationship Management (managing partners). It consists in making a CRM application available to business partners – most often through the Internet. They can use it in the diversified extent, depending on the pursued policy. Thanks to that, the owner of the CRM system can systematically follow all actions of partners, their commercial actions, forecasts and plans resulting from the data, they enter into the application.

9. Knowledge Management (knowledge management). There is a possibility of creating of any category and subcategory of the entered information as well as contextual searching for the collected information, including publishing them in the company Internet. Furthermore, the application of managing documents facilitates their storing and making available of chosen information for users, as well as of attaching marketing documents in any format (text, graphics, and video).

10. Business Intelligence (data mining). It is through the function of supporting market researches that the system gives the possibility of building forms. Additionally, it collects data from them and analyses them. It also gives a possibility of forecasting and planning any variables on the basis of the data from the CRM base. **E-business.** The base is functioning of online shops. The one supported by CRM systems increases the sales volume. The system, on the basis of the current shopping of the customer, analyses his interest and submits a next offer to him, which perhaps will meet his expectations. After placing an order, the customer can follow the realization status of his order.

11. Workflow (group work). It consists in defining processes, which occur in the company, the way of the document and the information flow. It is for its designing that special graphic tools are used. It assists in assigning tasks to individual persons and groups at all stages of the process. It also notifies on approaching deadlines. Summarizing the above information, it should be stated that properly implemented CRM systems support the company management at all levels. Without any doubt, they make the work easier both in large corporations with extended organizational structures as well as in average and small-sized enterprises.

3. Planning the CRM system

The CRM system causes the change of the operations of the entire company. This change is not the consequence of the implementation of the system, but one of its fundamental objectives. The appropriate planning determines the success or the possible failure of the entire implementation. Therefore, the CRM implementation program requires understanding and the strong dedication to customer orientation as well as the compliance with its goals. Furthermore, it is both from the management and the employees that the constant vigilance and commitment in relations with customers are required. The success of the system depends on the entire company[10]. The effective CRM system changes both the way, in which the organization cooperates with customers but also the way, in which the buyers cooperate with the company. The tendency of employees to the change of their duties and processes constitutes the key component of the success.

The CRM as a computer system is not a system, which every average company and much less a large company should have. The organization cannot be a subject to the trend and invest in the system, without which it efficiently works for this reason. While determining real opportunities of the implementation, the company should analyse, whether it has a sufficiently large number of customers as well as whether it carries enough transaction out. If the reply to one of the above issues is negative, the investment in the big management support system for relations with the customer does not have any justification. Simultaneously, the companies, which offer rather small number of products or support few markets, should also not implement it. CRM is combined with after-sales services i.e. the service and the technical support. Therefore, the companies, which

[10] J. Dyche, *CRM customer relationships,* Helion, Gliwice 2002, p. 149.

do not have such services in their offers, should consider the implementation of the system of the CRM class[11].

All companies, which want to move towards CRM, should correctly prepare for it. It is below that the basic steps are presented, which should be carried out to enter the path to CRM. In particular, they include analysis of all areas of activity of the organization, which are essential from a point of view of the effective implementation of CRM. It is in order to prepare correctly the company for the implementation of the CRM concept that one should determine main reasons of the implementation and then settle, what one wants to achieve thanks to it. It is also important to analyse of the current business model of the company and to evaluate its current adaptation for implementing guidelines of CRM. It is worthwhile also to estimate the influence of the implementation of the system on the general corporate strategy. It is in order to bridge the gaps in the process of planning that additional steps should be taken like examining the risk of the failure of the implementation of the system in the given company. It is simultaneously essential to analyse the benefits of the implementation of the system for the organisation[12].

In order to understand how much the correctly implemented CRM system can bring, it is necessary to define clearly the benefits for the company. According to the classification suggested by A. Stachowicz-Stanusch, they can be divided into two basic groups. It is the first one of them that advantage at the strategic level constitutes. One may include here[13]:

- the possibility of obtaining of the synergy effect thanks to the cooperation of the company with chosen crucial customers;
- increasing the customer loyalty through their satisfaction;
- increasing sales and simultaneously profits generated by the company;
- implementing the consistent customer service system for the entire company.

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[11] J. Walas-Trębacz, *CRM – business strategy and tool supporting customer relationship management* [in] B. Domańska-Szaruga (ed.), *Building customer relationships*, Studio EMKA Publishing house, Warsaw 2009, p. 51.

[12] W. Grudzewski, I. Hejduk (ed.), *The company of the future – strategic vision,* Difin, Warsaw 2002, p. 324.

[13] A. Stachowicz-Stanusch, M. Stanusch, *CRM Guide for implementing staff,* Placet Publishing Agency, Warszawa 2007, p. 117.

It is necessary to wait for the above results most often for some time. These benefits will be visible only after about one year from the date of the implementation of the system.

The second group of the benefits is created by the ones experienced by individual users of the system. They are termed operational benefits. We rank increasing productivity and reducing operating costs above all among them. It is possible mainly thanks to[14]:

- reducing the time that sellers allocate for administrative activities;
- increasing the effectiveness of performed after-sales actions;
- reducing costs of the recruitment and staff trainings;
- reducing the number of the customer complaints;
- increasing the efficiency of promotional measures at simultaneous reducing their costs;
- reviewing sales departments' functioning as the result of the assessment of conversations with customers.

Most of these benefits are possible to notice soon after the implementation of the system and are more and more visible along with users' are getting acquainted with the system. Furthermore, according to the experience of the companies, which effectively managed to introduce the CRM system, they managed to reduce operating cost even by the 30%.

There were discussed benefits above that result from the correctly planned and introduced CRM system. However, in spite of numerous benefits, there are also problems at the stage of the process. The companies experience many problems and they make also costly mistakes. The most important ones were characterised below[15].

Technological rather than process approach. While introducing the CRM system, it is often forgotten that it is a philosophy of a company not computer software. Its implementation indicates above all the change of the company policy, processes occurring in it and the organizational culture. In fact, the companies implementing CRM solutions excessively confine only to the technology sphere focused on due configuring the software.

Biased pre-execution analysis. The implementation of the CRM system is inseparably associated with the corporate strategy. The companies executing the pre-execution analysis often limit themselves for diagnosing the spheres associated with the functionality of the given software omitting analysis of substantive guidelines for the existence of the

[14] *Ibidem*, p. 118.
[15] *Ibidem*, pp. 133-134.

company. Such approach causes that not all needs of customers are identified and the system is implemented up to the current concept of management rather than the one being based on the CRM concept.

The start of the implementation at the moment, when the company is still not prepared for it. It happens many times that companies invest in CRM systems disregarding that their models of the business do not match the concept of the management outlined by CRM. The philosophy, which sometimes requires changes in the approach towards buyer, the manner of the support, the verification of the company's objectives, motivation systems and often in the very strategy. Such problems emerge only at the moment of the start of the implementation, what affects its extending in time and increases costs.

The inappropriate choice if the IT solution. There are currently several dozen systems of the CRM class in Poland at present offered by companies. They are diversified both under the price as well as the functionality, from basic managing contacts with the customer till developed systems. Due to the lack of objective norms and standards, it is not possible to compare them very often. Simultaneously, it may happen that the system matching the current model of operating of the organization will not be useful in future.

In order to create a proper CRM system, it is necessary to develop a detailed, solid plan, in which all aspects necessary for achieving success will be included: people, techniques and processes. The next important element is to formalize the approach towards RIO (Return on Investment). RIO is a profitability ratio applied in order to estimate the profitability of the return on the investment. Generally, this indicator puts together costs incurred for given investment to generated (anticipated) income. It is in CRM that the ratio has to take into account[16]:

- the costs of investment (the purchase and the use of CRM);
- the change in operating costs resulting from the implementation of CRM;
- the change in profits on sales of products and services;
- the non-measurable benefits (among them the higher level of customers' and employees' satisfaction).

The next important element is the choice of relevant components for the CRM implementation. There are two fundamental classes of tools to

[16] A. Mazur, K. Jaworska, D. Mazur, *CRM Customer Relationship Management,* MADAR, Zabrze, p. 17.

distinguish: first one helps to get data, however the second one supports analysts in acquiring the information from the data warehouse. The main reason for creating data warehouses is the possibility of taking decisions in relation to the segmentation of buyers and associating products with specific profiles of customers. Archaeology of the data in the CRM system consists in the accumulation of the information about customers and products. The levels, on which the information should be kept, are in particular[17]:

- Contact information: who the customer is, what are the methods of reaching him;
- Information on the household: what links exist among customers, whether there is a possibility of applying group promotions;
- Group Information: with which groups customers are connected, history of the customer;
- History of the promotion: what current promotions resulted in the desired effect;
- Purchases of products: whether it is possible to classify behaviour of the buyer depending on the type of purchased products and the size of the purchase;
- History of the interaction: the channels being the best way of contacts with the customer.
- Comparing, collecting, uniting and removing the repeating information as well as the data management is a big challenge.

One of the most difficult elements by implementing the CRM system is to determine the measures of successes. It is important to recognize the organizational limitations for the system at the very beginning. In fact, the entire enterprise, starting from managers to programmers, must adapt the identical vision of CRM. These are mainly long-sighted managers that emphasise it, since it allows for creation of the general-company CRM program. As it can be seen, the organization must consider numerous aspects before implementing the CRM system. However, the efforts put into the planning stage will allow avoiding problems in the future. It is essential to convince the whole company of the need of CRM system implementation starting from the management board through employees of individual divisions, who will work with the system. While summarizing the above information, it must be stated that there are a lot of problems, which have to be faced by companies wanting to introduce the CRM

[17] W. Grudzewski, I. Hejduk, *Methods of designing of management systems,* Difin, Warszawa 2004, p. 140.

system. While facing them, the company has to be sure that the given system is essential. Furthermore, it must demonstrate the determination at every implementing stage. The fact that the experience of consulting companies in this respect is increasingly bigger is an advantageous aspect. It is necessary above all to answer the question, in which extent the CRM system is needed by the company.

4. The choice of tools and the CRM implementation

The main challenge of the modern CRM system is to increase the number of loyal customers. In order to achieve it, the company must be transformed into a customer-oriented enterprise in all areas of its activity – its marketing, sales and customer service. The identification of key interactions in the life cycle of customer and understanding his expectations are elements of this process. By the CRM system is meant the software supporting the registration and the accumulation of data, planning events with customers and analysing the registered information in all sorts of sections. The implementation of this strategy requires the considerable knowledge about the own enterprise and customers, at who we direct services or products. It also requires much effort from all employees of the company.

The implementation of the CRM system is associated with high costs of purchasing the required software, consultation but also because of the time devoted by employees for accustoming to it. This system positively affects the way of performing the work by the team responsible for contacts with customers, what directly reflects in getting new orders and carrying out the earlier ones. In order to implement the CRM system with a success, the absolute approval of the team for customers is required. The analysis of processes occurring in the operations of the organization, of the CRM role in its plans and objectives, which will be achieved as the consequence of CRM implementation, is essential. These aims can include[18]:

- increasing the number of new customers;
- reducing the number of customers abandoning the partnership;
- shortening the sales cycle;
- more effective using possibilities;
- applying new channels of the market penetration.

[18] K. Burnett, *Relationships with key customers,* Oficyna Publishing House, Kraków 2002, p. 287.

After determining such objectives and setting priorities, a form of map is created to choose an appropriate system.

The procedure of creating the system of the consumer relationship management includes activities associated with planning, forecasting and the analysis of customers. All actions taken in order to implement the system and its development can be defined as the process of its improving. K. Burnett mentions eleven steps of the implementation of the CRM2 system[19]:

1) formulating and understanding objectives of the company and the evaluation of its key competencies.

2) Preparing an overall business plan.

3) Creating the database on customers and identification of key customers.

4) formulating the strategy of keeping and developing key customers.

5) calculating needs and organizing team for key customers.

6) providing motivation for team members and gaining support of the higher management.

7) preparing detailed development plans on relations with key customers.

8) establishing the system of evaluations of the customer profitability.

9) creating the information system on customers.

10) creating the system of satisfying customers.

11) Joint negotiations in order to achieve the stability and the profitability.

The implementation of the CRM system is a long and extensive process. There is no explicit, universal development scheme. The more complicated the final version is, the more extended the implemented project is. Therefore, there are distinguished two ways of the effective implementation of the system. The first one covers the space from the operating to the general-organizational variant. The second one determines detailed steps by implementing.

In spite of existing differences in the ways of implementing CRM systems, there are some permanent measures of the success by developing the system, which apply to every project. One may rank among them[20]:

The gradual development. It means that the enterprise gradually receives the next scope of the CRM functionality in equal intervals. It

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[19] U. Kałążna-Drewińska, *CRM systems in the process of customer relationship management* [in] B. Domańska-Szaruga (ed.), *Building customer relationships,* Studio EMKA Publishing House, Warsaw 2009, p. 128.

[20] J. Dyche, *CRM customer relationships,* Helion, Gliwice 2002, p. 221.

arises mainly from the fact that the majority of divisions of the company cannot adopt complicated changes of functions and processes, which are associated with entering the new system at once. The next CRM stages create good atmosphere amongst the interested parties of employees and members of the management who see its value for themselves. Another possibility of implementing the system is to introduce all its functions at once. However, it is associated with rapid changes within the company and unpleasant events resulting from it appearing very often.

Development determined by requirements. It means that for creating and adapting individual functions according to the expectations of the company, the persons developing the CRM are responsible. Moreover, they are aware of the significant functionality to it. Implementing the system according to the requirements ensures that users will receive what they exactly expected.

Continuous user involvement. It is very often that teams introducing CRM systems involve users from companies only at the beginning and at the end of the process. Simultaneously, they omit the middle period of its development, which is also very essential and sometimes has a primary importance. It means that final users assess the concept, determine the thematic scope of CRM. Moreover, there is a regular communication amongst the developing team and employed employees as well as the founder of CRM.

Rigorous implementation process. In order to optimize the implementation of the CRM system, it must be planned and carried out according to structured processes. It will ensure the accurate knowledge of the range of activities of individual individuals and employees at every stage of development activities. Furthermore, the properly designed implementation plan will ensure that the involved persons will focus on the very implementation to a lesser degree and will direct their attention for real delivering the valuable functionality to the CRM system.

Enterprises are more and more ready for organizational amendments brought by the introduction of CRM systems. The providers of IT systems aware of it, having an adequate knowledge and experience are also ready to take the risk associated with the investment in systems of such type. After delivering the installation and training, the technical problems associated with the implementation should be solved. Because it is very often that the requirements for the system grow along with the development of the enterprise and increasing the functionality of assisting solutions – and

hence of the knowledge and the automation. The changes brought by CRM systems are processes embracing the entire organization. The cooperation of the company with the supplier of computer systems becomes essential, so as that the entered technical solutions aim at appropriate objectives. It is worthwhile to notice for summarizing that introducing CRM systems brings more benefits than losses even though its implementation can be very expensive at the beginning. It should be noticed that CRM facilitates the work of users, what results in their becoming more effective and their contact with the customer is faster and more efficiently. The company furthermore gains the better contact with buyers and the correctly introduced system contributes to the great marketing success.

5. Conclusions

The experience of the last years shows that enterprises, which occupy the dominant position on the market owe their success to the customer-oriented strategy. In order to meet fully the needs of customers, the company must learn them first, what is supported by CRM tools. They enable to reach customers directly, at the time and the place favourable for him, by using means of communication most popular with a given person. These tools increase the effectiveness of actions of the company and the effectiveness of the communication between the parties. They enable the accumulation and analysis of the obtained information, which are one of the most valuable resources of the company. The competent use of the knowledge dispersed in the entire organization is a determinant of the success of the company.

The implementation of the CRM system is not only the installation of the software allowing to increase the productivity but also the change of the way of thinking of the entire organization and the careful preparation and planning all actions. The CRM implementation should always be started with defining the objectives and preparing the right business strategy. It results in amendments in the organization, the culture and processes. However, the changes and achieving the benefit from them are possible thanks to application of the IT technology. Just such a sequence allows the effective implementation of the CRM strategy. The reverse approach consisting in beginning the implementation with the technology never is effective in practice.

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THE ECONOMIC IMPACT OF FINANCIAL ABUSE, FINANCIAL CRIME AND MONEY LAUNDERING

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Abstract. *This study provides an overview of economic impact of financial abuse, financial crime and money laundering. It reviews the very limited empirical and indirect evidence on the magnitude of these phenomena. Financial system abuses and money laundering induce negative consequences on macroeconomic performances and economic growth. There is a positive relationship between the volume of laundered money and economic growth because an increase of dirty money volume generates short term economic growth.*

Financial abuse, financial crime and money laundering also impose welfare losses and have negative cross-border negative externalities. Globalization facilitates financial system abuses, but economic damage can also arise from poor regulatory frameworks.

In our opinion these findings could provide a critical judgment and decision support for anti-financial-crimes national system.

Keywords: *financial abuse, financial crime, money laundering, economic growth, GDP.*

JEL Codes: G18, H28, O17.
REL Codes: 8E, 8K.

1. Introduction

Money laundering is an illegal activity through which criminal proceeds take on the outward appearance of legitimacy. Laundering is a necessity for any profit-generating by criminal activities. Without the ability to launder their illicit proceeds, criminals fail because money sustains, motivates and gives them power. Narcotics traffickers, perpetrators of financial fraud, organized crime groups and others invest considerable effort into laundering their illicit proceeds.

Internationally money laundering is most often described as the "turning of dirty money into clean money". According to Interpol's definition, money laundering consists in "any act or attempt to conceal or disguise the identity of illegally obtained proceeds so that they appear to

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have originated from legitimate sources". Generally, the act of conversion and concealment is considered crucial to the laundering process. Perhaps the simplest definition is that money laundering is the process of converting cash, precious assets or other property which is derived from illegal activity, so as to give it the appearance of having been obtained from a legitimate and legal source (Shah et al. 2006).

Money laundering generally involves a series of multiple transactions used to disguise the source of financial assets so that those assets may be used without compromising the criminals who are seeking to use them. Money laundering methods also vary depending on the parties involved, in some cases simple methods are suitable, and in other instances complicated schemes are used.

There are three essential objectives that a comprehensive money laundering operation satisfies: (1) it *converts* the bulk cash proceeds of crime to a less suspicious form, (2) it *conceals* the criminal origins and ownership of the funds and/or assets, and (3) it *creates* a legitimate explanation or source for the funds and/or assets. To realize the greatest benefit from money laundering, criminally-derived cash should not simply be converted to less suspicious assets, but the illicit financing of the assets must be also hidden. The third objective is no less important than the former two and concern the effectiveness of a laundering scheme. It will ultimately be judged by how convincingly it creates a legitimate front for illegally-acquired cash and assets. In short, "money is not truly laundered unless it is made to appear sufficiently legitimate that it can be used openly, precisely what the final stage of the cycle is designed to achieve" (Naylor, 2002).

Although there are many ways to launder money, typical scheme involves three stages: *placement, layering and integration*. Through these processes, a criminal tries to transform the monetary proceeds derived from illicit activities into funds with an apparently legal source.

In the *placement stage*, the launderer places the illegal funds into the formal financial system by using formal banks, high value goods acquisition, properties and assets acquisition etc., in order to remove the illegal funds in a way that allows escaping from authorities' detection. After placing the funds in formal economy, the launderer will try to conceal the source of illegal money through a process named *layering*. In his attempt to distance the funds of their illegal origin and to create confusion, the launderer will set up multiple financial transfers and transactions. In the *integration stage*, the launderer reintroduces the funds back into the formal economy. He will invest his money in real economy by using all the possible methods to bring the funds legitimacy.

Some authors (Schneider, 2004) consider that the final stage of the process involves *repatriating* the laundered funds into the hands of the criminal entrepreneur, ideally with a legitimate explanation as to their source, so that they can be used without attracting suspicion.

Money laundering can occur practically anywhere in the world. Generally, money launderers tend to seek out areas in which there is a low risk of detection due to weak or ineffective anti-money laundering programs. But launderers usually prefer to move funds through areas with stable financial systems because the objective of money laundering is to get the illegal funds back to the individual who generated them. This activity may also be concentrated geographically according to the stage the laundered funds have reached.

2. Money Laundering in Romania: Nature and scope

We have examined all relevant documents contained within the relevant dates in order to identify as much information as possible on the predicate criminal conspiracy, how the criminal proceeds were disbursed by offenders, and any money laundering techniques used. This data generally came from reports prepared by Romanian National Office for Prevention and Curbing Money Laundering. Other police documents that proved useful for this study included court transcripts, investigative progress reports, court briefs, intelligence reports, and "statement of facts".

Certain factors conspired to potentially limit the reliability of the data and the ability to extrapolate the research findings to the broader universe of money laundering in Romania. These limitations are the result of the inherently secretive nature of money laundering, the reliance on law enforcement cases as the primary source of data.

Dirty money is generated through various activities such as: frauds, tax evasion, deception crime, transnational crimes (under/over invoicing foreign trade deals to accumulate wealth abroad or change black money into white money), crimes provided by Customs Code, drug trafficking, corruption and bribery, fraudulent bankrupt, crimes provided by Law no. 535/2004 concerning prevention and curbing terrorist acts, counterfeiting and cyber crimes.

While there are a myriad of entrepreneurial criminal activities that produce substantial revenues, according to public information, tax evasion represents the largest source of criminal proceeds in Romania. The legislative, economic and social situation has made the proliferation of tax evasion phenomenon possible. This is an important part of underground

economy and it is ubiquitous in all areas of income generating activities. Taxation stimulates the Romanian tax payer's ingenuity determining him to seek and apply different procedures in order to circumvent the law. Romania has also created the necessary and sufficient conditions for tax evasion: instability of tax legislation, inconsistencies and legislative gaps, useless law concerning tax evasion, bureaucratic corruption, but also the existence of a higher fiscal pressure, an unequal relation between taxation and taxpayer real capacity to pay tax obligations.

In 2010, as Figure 1 shows, 65% of cases involved a designated tax evasion as the predicate criminal activity. The second most common predicate offence was committed against the Law on Commercial Companies (deception crimes) 15%, and 10% against the Customs Code and/or the Excise Duty Act, which primarily consists of the highly profitable international trade in contraband, smuggling and drug trafficking.

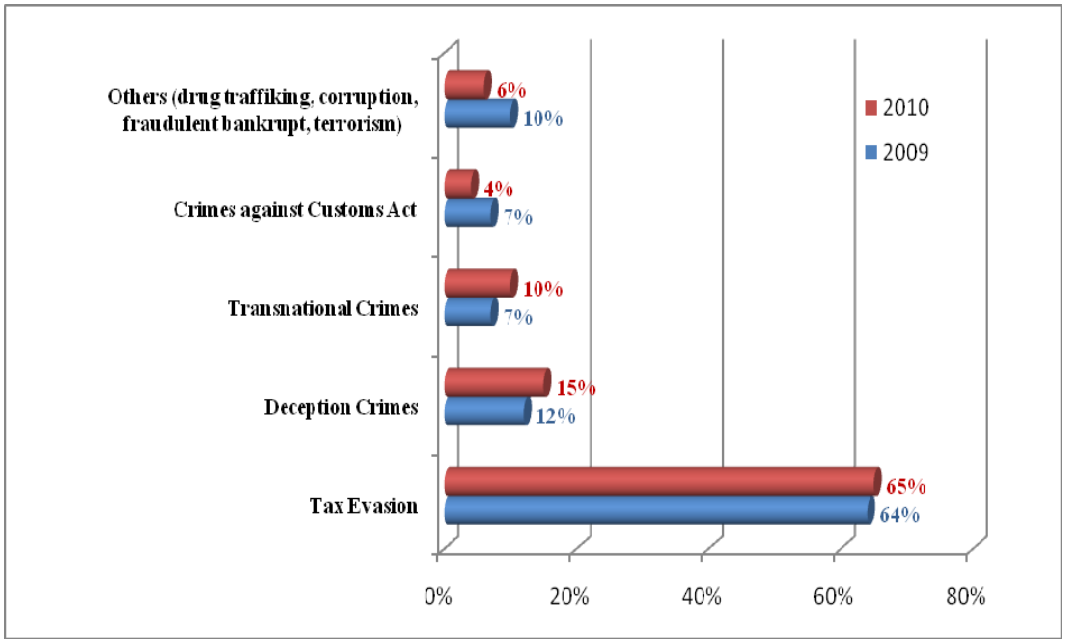

Figure 1. Offences that generated the proceeds of crime.

Source: Annual Activity Reports of National Office for Prevention and Curbing Money Laundering (2009, 2010) and own calculation.

In the course of a single money laundering operation, a number of different sectors are often used. Moreover, when used for money laundering purposes, these sectors are not mutually exclusive, but interconnected: one sector of the economy, such as domestic and international trade, will frequently be used to access other sectors, such as real estate, services and

even other countries (through wire transfers). Others listed are industry, administration, gambling, insurances, leasing, securities etc.

The study findings indicate that criminal proceeds find their way into a number of different economic sectors in Romania. Figures 2 and 3 identify these sectors and the frequency with which each was the recipient of criminal proceeds, based on the public data.

In many of the identified cases, the expenditure of illegally-derived revenues was so lackadaisical and unimaginative that the money laundering objectives and processes laid out above were barely satisfied. In other cases, millions of dollars of criminal funds were proficiently cleansed through elaborate operations that involved numerous economic sectors, dozens of professionals, a myriad of illusory guises and techniques, and hundreds, if not thousands, of obfuscating transactions.

In short, one should not be overly pre-occupied with the term 'money laundering'. For both analytical and law enforcement purposes, attention should be paid to how the proceeds of crime are disposed by the criminal element – with particular emphasis on how it enters and circulates within the legitimate economy – regardless of whether these transactions satisfy the definition of money laundering.

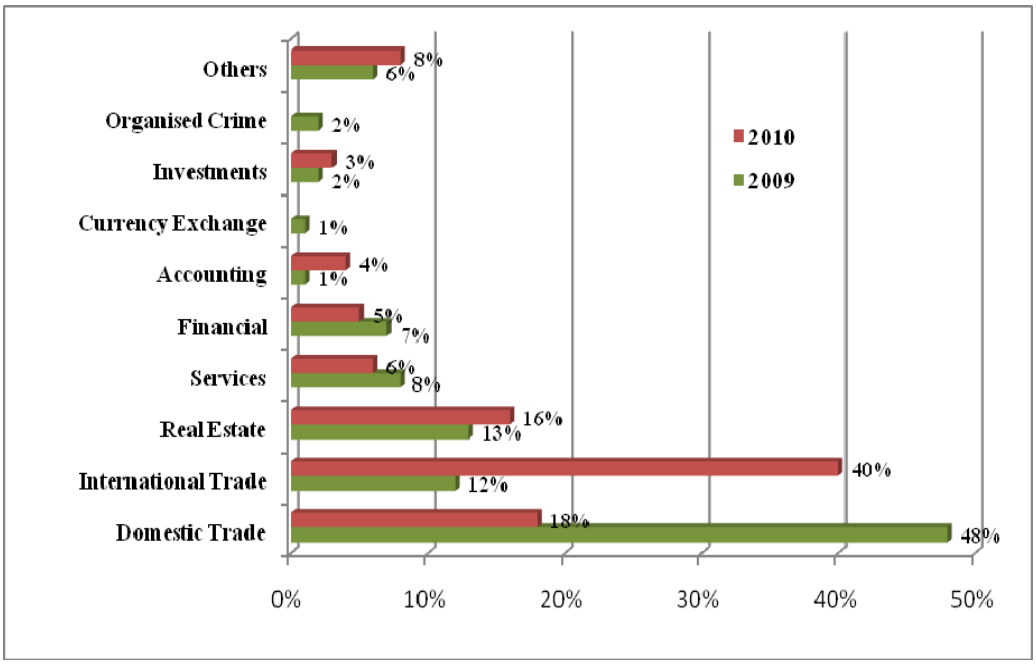

Figure 2. Economic sectors and other assets used for money laundering in Romania (Percentage of all cases)

Source: Annual Activity Reports of National Office for Prevention and Curbing Money Laundering (2009, 2010) and own calculation.

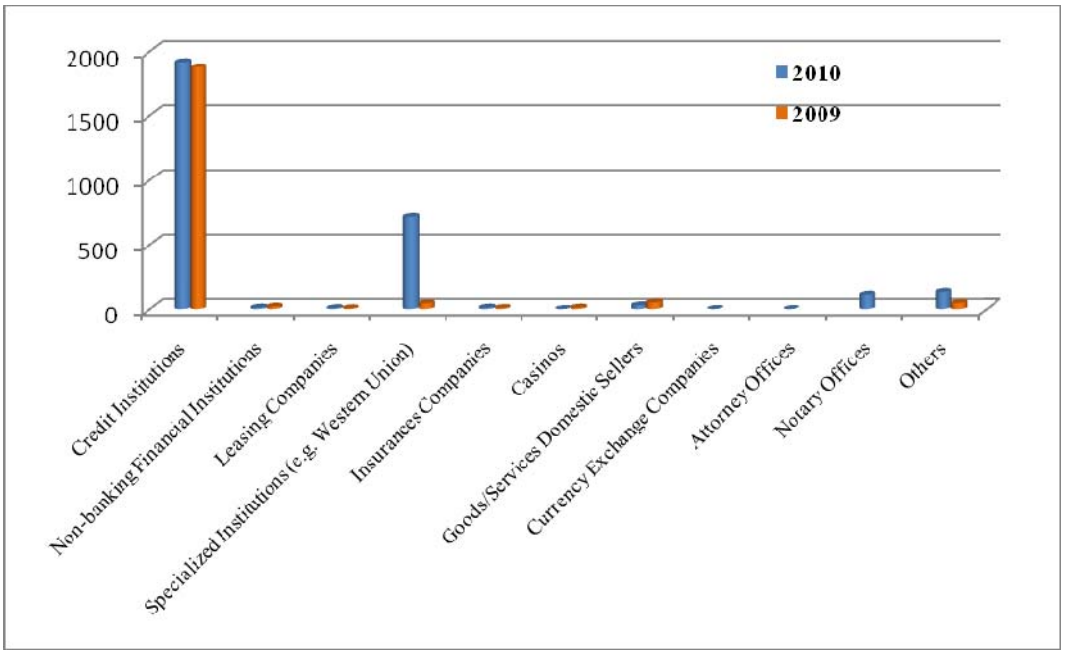

Figure 3. Formal economy companies used for money laundering: An overview

Source: Annual Activity Reports of National Office for Prevention and Curbing Money Laundering (2009, 2010) and own calculation.

As indicated in the above graph, credit institutions, currency specialized money transfer institutions (e.g. Western Union), companies selling goods/services, and real estate are the four most frequent destinations for the proceeds of crime in Romania. Credit institutions are the single largest recipient, having been identified in 1915 of the Romanian National Office for Prevention and Curbing Money Laundering cases in 2010 (65.47%). While the currency transfer specialized institutions were implicated in almost 25 percent of all cases, in the vast majority, the offender did not explicitly seek out the insurances and leasing companies. In a small number of cases, the insurances companies were used as a financial service provider to launder the proceeds of crime. In these cases, mortgages, investment certificates, life insurance policies, and mutual funds were provided by or purchased from a broker.

Currency exchange companies and cheque cashing businesses were insignificantly implicated. Currency exchange businesses are most frequently used during the first stage of the money laundering process: converting large and conspicuous amounts of cash into less suspicious denominations or alternative currencies. As such, currency exchange businesses constitute a significant portal for the entry of the illicit cash into

the legitimate economy, and by extension represent an important player in the efforts to combat money laundering.

Currency exchange businesses are also attractive to money launderers because they increasingly offer other products and services conducive to money laundering other than currency exchange. These alternative services include wire transfers and bank drafts, among others.

The purchase or sale of goods and services was implicated in 29 cases (1%). Other assets purchased with the proceeds of crime were notary offices (108 cases), jewellery, precious gems, or gold, rare coins, art work, and livestock, including race horses (130 cases). Legalized gambling, in particular casinos and lotteries, were used to launder funds in one identified case.

Money laundering through a casino entails purchasing chips with the cash proceeds of crime and then eventually cashing in the chips for larger denominations of cash or a cashier's cheque. An added benefit is that the proceeds of crime can be claimed as legitimate casino winnings. Some casinos have taken steps to combat money laundering by prohibiting certain cash transactions that could lend themselves to money laundering, such as cash-for-cash exchanges involving small denomination bills for larger denomination bills in amounts over Euro 15,000.

The insurance sector was not expressly sought out by criminals to launder their illicit revenues. Instead, insurance policies were purchased because big ticket items that require coverage – such as cars, homes, and businesses – were acquired (with the proceeds of crime). As such, in most cases, the insurance sector was somewhat tangential to the actual money laundering objectives and processes. In a smaller number of cases, the insurance sector was used much like a bank. As the barriers that separate the different financial sectors continue to tumble in Romania, insurance companies are increasingly providing the type of banking services favoured by money launderers.

The identified cases show that the proceeds of crime were expended in the legitimate economy, not only for personal consumption and laundering purposes, but also to purchase equipment necessary for the continuation of predicate criminal conspiracies, including marijuana cultivation equipment, weigh scales, slot machines, generators, mobile phones and pagers, boats, tractor-trailers, and computers, among others.

Cash was the principal form in which the proceeds of crime entered credit institutions. Combined with the frequency with which they are used to launder the proceeds of crime, this situation indicates that banks

continue to constitute the most foremost entry point for the proceeds of crime into the legitimate economy.

Banks are used more frequently to launder the proceeds of crime than any other single sector of the Romanian economy. Because of their very nature, banks and similar financial service providers are highly conducive to satisfying the objectives of the laundering process. First, they can be used to convert the cash proceeds of crime into less suspicious assets. Second, banking services and instruments, such as cheques, wire transfers, bank drafts, and credit cards can be used can be used to access other laundering vehicles. Third, money laundering techniques intended to conceal the criminal origins of the illicit funds can be used in tandem with banking services, such as registering accounts or purchasing monetary instruments in the names of nominees. Finally, deposit institutions can be used as part of a laundering scheme that creates the perception that the illicit funds were derived from legitimate purposes, primarily by establishing commercial accounts and depositing the proceeds of crime under the guise of legitimate business revenue.

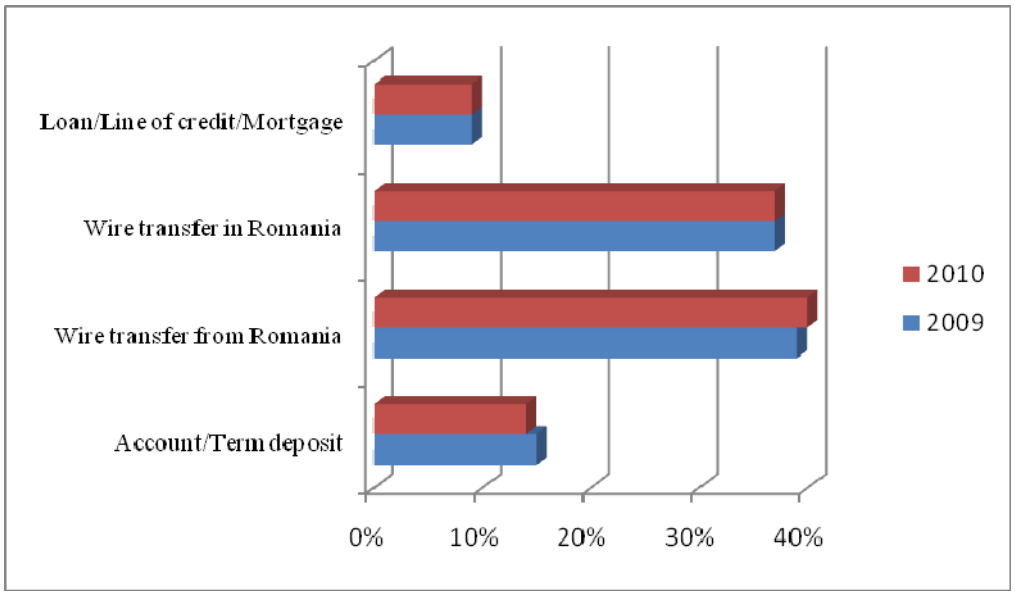

Figure 4. Banking products and services purchased/used with criminal revenues.

Source: Annual Activity Reports of National Office for Prevention and Curbing Money Laundering (2009, 2010) and own calculation.

Depositing the cash proceeds of crime into a bank account is frequently the first step in the money laundering process and is used to access other laundering vehicles within the deposit institution or other

similar. Bank accounts relieve the criminal entrepreneur of cumbersome amounts of cash, while allowing the funds to be spent, invested, or transferred electronically without attracting the level of suspicion associated with large volumes of cash. As such, a savings or cheque account represents the most common portal through which illegally-derived cash enters a bank and, by extension, the legitimate economy.

Wiring funds is tantamount to sending cash instantly to a different branch, a different bank, and even a different country. Indeed, one of the advantages of a wire transfer for money laundering purposes is that it is not confined within national borders; increasingly, they are used for the express purpose of spiriting illicit money outside the country of origin, whether for money laundering purposes or to purchase drugs or other contraband.

In the context of a money laundering operation, transferring funds between different bank accounts is often used as part of the layering process: to hide the criminal source and ownership of the funds and to obscure any audit trail. In particular, account transfers are used to funnel money into the accounts of nominees, to conceal the connection between the beneficial owner of the funds and their criminal origins, and to pay for supplies and other expenses associated with criminal activities.

While many criminal entrepreneurs certainly have no shortage of cash to invest in real property, mortgages are nonetheless obtained, either to avoid suspicion associated with large personal financing or because the purchaser genuinely requires credit lines. There is also some evidence that criminal entrepreneurs seek out a mortgage to limit their equity in a home, which in turn minimizes their personal financial loss if the property is forfeited to the authorities.

3. Professionals in money laundering

Because most of the money laundering cases involved the use of at least one sector of the legitimate economy, it was inevitable that the launderer or an accomplice came in contact with a professional. When more than one laundering vehicle is used, a number of professionals will come in contact with the proceeds of crime. We refer to those persons with specific skills and expertise who can provide a criminal entrepreneur with specialized services, advice, and access to industry insiders. Lawyers and accountants are the most sought-after professionals, with financial advisors, notaries and insurance agents. Front-line staff of retail businesses that come into contact with criminal entrepreneurs in the course of their

day-to-day money laundering activity, including bank tellers, real estate agents, automobile sales people, currency exchange staff, and jewellery dealers, among others are also favoured.

Professionals could be innocently implicated. They have no knowledge of the source of the funds, or there are any overt circumstances surrounding the money, the client, or the nature of the transaction that would have raised suspicions. However, in some cases the transaction is clearly suspicious, such as the use of large amounts of cash to purchase big ticket items, using multiple bank drafts from different banks to personally finance the purchase of a home, requests that lawyers purchase assets on behalf of a client through cheques issued from legal trust accounts, and the incorporation of numerous companies that carried out no legitimate businesses, yet have significant amounts of cash deposited into corresponding bank accounts. In some cases involving suspicious transactions no reports were made, indicating that the professional was either uneducated on suspicious transactions or was wilfully blind to the suspicious circumstances.

Some of these professionals are concerned to hide the true source and ownership of illegally acquired cash and other assets in order to avoid suspicions that may stem from transacting in large amounts of cash, or to create the perception that the funds were derived from a legitimate source. This is an attempt to hire the direct connection between launderer assets, primarily by registering legal title to the asset in the name of another individual, usually a relative, a friend, business associate, or a lawyer, persons usually unconnected with criminal activities and having no criminal records.

4. Conclusions

The negative economic effects of money laundering are difficult to quantify just as the extent of money laundering itself is difficult to estimate. The International Monetary Fund, for example, has stated that the aggregate size of money laundering worldwide could be somewhere between 2% and 5% of global gross domestic product. Yet it is clear that such activity damages the financial-sector institutions, reduces productivity in the economy's real sector by diverting resources and encouraging crime and corruption, which slow economic growth, and can distort the economy's external sector – international trade and capital flows – to the detriment of long term economic development. However, the Financial Action Task Force (FATF) notes that it is near impossible to successfully

estimate the percentage of illegal money in the global economy. Nevertheless, countries search to prevent this prevalent issue as governments struggle to rid their economies of illegal funds.

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PERFORMANCE AUDITING – A COMPLEX CONCEPT

Anda GHEORGHIU*

Abstract. *The paper analyses the complex concept and tools of performance audit. It explains the way companies or public institutions appraise their programs, functions, operations or the management systems in order to achieve economy, efficiency and effectiveness in the employment of existing resources. The case study refers to the recent efforts of Romania to implement the INTOSAI standards, striving to comply also with the procedures of the European Court of Auditors.*

Keywords: *performance audit, INTOSAI, 3 E's, efficiency, effectiveness.*

1. Introduction

In the last decades, the internal audit has become one of the most important tools of companies, public institutions and other types of organizations to discover malfunctions of their operations, to minimize risks, to develop their systems and, above all, to achieve their goals.

Personally, I have always been interested in such a complex area and profession, that offers not only a great exposure to virtually all operating areas within an organization, but also the chance to help it with useful recommendations, that can add value, quality, and improve its processes, procedures, management style. In the late nineties, as a Senior Auditor of PricewaterhouseCoopers ABAS department in Bucharest, me, together with my colleagues, have provided consulting and financial auditing services for various multinational companies, as well as for small and medium enterprises and this experience has opened me the eyes over such an interesting domain and to learn enormously from the achievements and failures of our clients, the auditees.

But, in those days, the term of internal audit was a mystery, completely unknown in Romania… it was also unlegislated. Adopting a special law for regulating the internal audit happened only several years

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later, in 2002, as part of the Aquis communautaire accepted by the country in the pre-adhesion to EU period.

After 2005, I have been directly involved in this captivating area, working as an internal auditor for the Romanian Ombudsman, a public institution introduced in Romania for the first time in 1991, by the new Constitution. The Ombudsman has as purpose the defence of individuals' rights and freedoms in their relationship with the public authorities; it is a forefront runner for democracy, and internal audit is a key function for overseeing the achievement of its goals.

Performance audit is a new concept in Romania, as in many other European countries, and not many people fully understand what it is, after all. In this research I try to explain what role it plays as a tool to implement a sound financial management.

2. What is performance audit?

The etymology of the word "audit" comes from early 15c., also from the Latin word auditus[1] "a hearing", pp. of audire "hear", denoting an official examination of accounts, which initially was an oral procedure. The audit is not a modern activity; the term developed after the XVIth century.

On the whole, the commonly use of the word "audit" is in finance and it means the examination by an outside party of the accounts of an individual or corporation. But the general sense is broader and refers to an evaluation of a person, organization, system, process, enterprise, project or product; the concept of audit covers many areas, such as quality management (according to ISO standards), IT audit, environmental audit, similar concepts also existing in project management, water management, and energy conservation.

The term most frequently refers to audits in accounting/finance field. The financial audit (which is an external audit) is defined as an independent professional review of annual financial statements of an organization. In Europe, the Auditor and/or the firm is registered as a statutory auditor in the public register of a public oversight body in an EU member state in accordance with the principles of public oversight set out in Directive 2006/43/EC of the European Parliament and of the Council (this applies to auditors and audit firms based in an EU member state)[2].

[1] *Online Etymology Dictionary*, © 2010 Douglas Harper

[2] Directive 2006/43 of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253 EEC.

The services provided by auditors are appreciated by investors, managers and creditors, since they confer an increased confidence in the financial statements. The best known international audit firms are so-called Big Four, consulting giants: PricewaterhouseCoopers, KMPG, Deloitte & Touche and Ernst & Young.

Auditors can be classified into two categories:

a) External auditors / statutory auditors – independent persons or firms engaged by the client subject to the audit, to express an opinion on whether the company's financial statements are free of material misstatements, whether due to fraud or error.

b) Internal auditors, who are employed by the organization they audit. They perform various audit procedures, mainly related to procedures over the effectiveness of the company's internal controls over financial reporting.

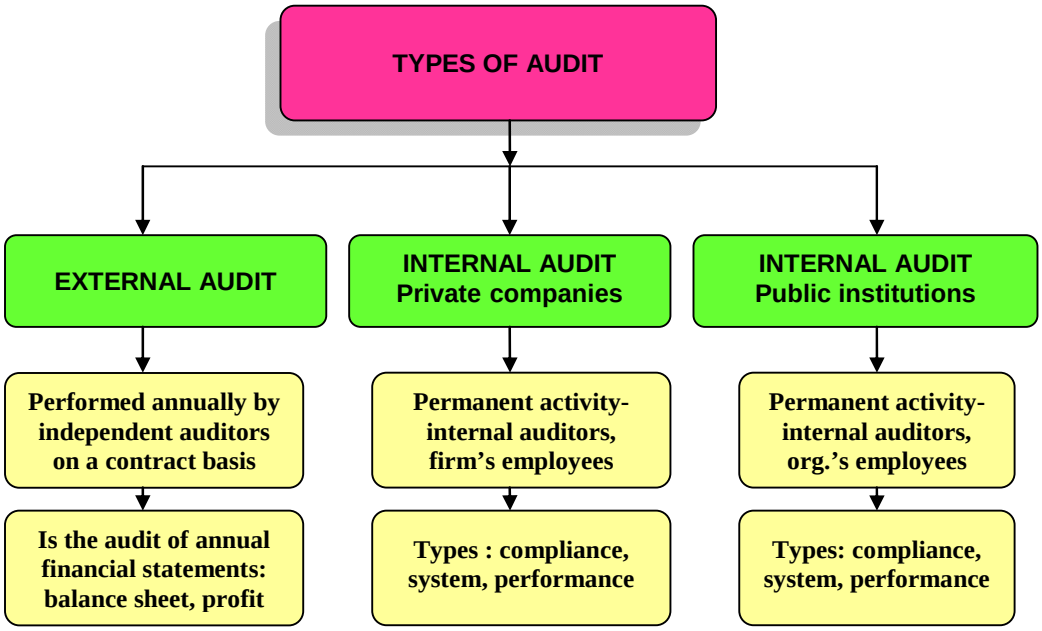

Figure 1. Types of audit.

Source: Anda Gheorghiu, http://www.id-hyperion.ro, Course of internal audit, e-learning platform, 2012, p. 14

Financial audit is regulated by the International Auditing and Assurance Standards Board (IAASB)[3], which is an independent standard-setting

[3] http://www.ifac.org/auditing-assurance/about-iaasb

body, founded in 1978, that serves the public interest by setting high-quality international standards for auditing, assurance, and other related standards, and by facilitating the convergence of international and national auditing and assurance standards. It focuses on three areas: object and scope of audits of financial statements, engagement letters, and general auditing guidelines. In 1991, the IAPC's guidelines were recodified as International Standards on Auditing (ISAs).

The most important professional body in the field of internal audit is The Institute of Internal Auditors (IIA) Founded in 1941, which is an international professional association with global headquarters in Altamonte Springs, Florida, USA. The IIA is the internal audit profession's international voice, renowned authority, acknowledged leader, chief activist, and main educationalist. Members work in many fields, such as: internal auditing, risk management, governance, internal control, information technology audit, education, and security.

The three types of internal audit are: compliance audit, systems audit and performance audit. What does these terms stand for?

1. A compliance audit is an ample review of an organization's adherence to regulatory guidelines;

2. A systems audit means to assess the internal control system of an organization, for example it is possible to assess the quality of the accounting system;

3. Performance audit basically deals with the efficiency and effectiveness of an organization. The performance audit is a relatively new field in audit theory as compared to other types of audits. This new type of audit has evolved to meet the need for greater information by the taxpayer and its representative, Parliament, mainly regarding the efficiency and economy in the use of resources by the public managers acting on behalf of the executive. The scope of performance audits may comprise the uncovering of fraud, waste and abuse, even though habitually these are not included in the scope.

A performance audit of public organizations is a systematic, focused, organized and objective examination of government activities. Its scope includes the examination of economy, efficiency, cost-effectiveness and environmental effects of government activities; procedures to measure effectiveness, accountability relationships, protection of public assets, and compliance with authorities. The subject of the audit can be a government entity or activity, or a government-wide functional area.

The International Organization of Supreme Audit Institutions, INTOSAI, issues The International Standards of Supreme Audit

Institutions, ISSAI. According to ISSAI 3000, a performance audit is "the independent examination of the efficiency and effectiveness of government organisations, operations, or policies, with due regard to economy"[4] .

Private firms have their own systems to assess whether activities are carried out efficiently; managers supervise the results of their activities on a monthly basis. Performance audits may be conducted by Internal Auditors who are employees of the entity being audited. Much more difficult is to proclaim if public funds are spent efficiently or not, given that defining performance and assessing it in an objective manner is more complicated than in the case of private firms. In most countries, performance audits of governmental activities are carried out by the external audit bodies at federal or state level. Performance audits may also be conducted by Internal Auditors who are employees of the entity being audited.

Performance audit and financial audit have a number of similarities. While the internal auditors first and foremost focus on effectiveness, the financial auditors focus on the correctness and fairness of the accounts. Financial and performance auditors have the same mandate to carry out the audit, the same responsibility to the client.

Performance audits can facilitate to improve financial and economic management by making available information needed to come to a decision to carry on, adjust or put an end to a measure, improve planning in potential analogous measures, inform stakeholders through feedback on the success or failure (achievement of goal, effect and economy) of measures they plan and implement.

The auditors should select and designs the audit tasks to be of highest impact; when selecting topics, they have to consider: the risks to performance or compliance for the particular area of revenue or expenditure, the level of income or spending involved, the time elapsed since any previous audit, forthcoming developments in the regulatory frameworks, political and public interest.

The department which is very much involved in periodically assessing the threats that can affect the organization's well functioning is the risk management department; it monitories and classifies a wide range of risks, as shown in Figure 2.

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[4] INTOSAI, *Implementation guidelines for performance audit: Standards and guidelines for performance audit based on INTOSAI's Auditing Standards and practical experience*, International Standards of Supreme Audit Institutions 3000 (2010), p. 11

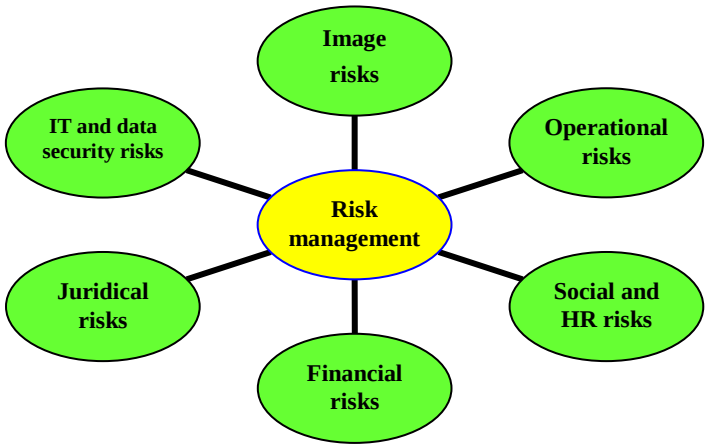

Figure 2. The department of risk management within an organization.

Source: M. Ghita, Ct. Iațco, C. O. Brezuleanu, M. Vorniceanu, *Corporate governance and internal audit*, Tipo Moldova Publishing, Iasi, 2009, p. 127.

External auditors are sometimes much more focused on performance audit comparing to internal auditors. The responsibility of such institutions to check how public money is spent requires a high awareness over a good management of public funds. Countries long and well-established democracies are more advanced in performance audit. For instance, the Belgian Court of Audit, which carries out audits at the federal level as well as the regional and provincial level, covers, among others, the following topics in its performance assignments: the organization working of the Special Tax Inspectorate, the knowledge and conservation collections by the Royal Museum of Fine Arts, the implementation of Kyoto Protocol, the use of scientific knowledge in healthcare policy, public-private partnership, support for people with difficulties integrating into the labour market, staff planning in government, rational use of energy in buildings etc.[5].

1. External audit organizations implicated in performance audit assignments.

Standards of performance auditing

There are various organizations that regulate the external audit performed over public funds, the most prominent being: The International Organization of Supreme Audit Institutions (INTOSAI), European Organisation of Supreme Audit Institutions (EUROSAI), USA Government

[5] De Jeremy Lonsdale,Peter Wilkins,Tom Ling, *Performance Auditing: Contributing to Accountability in Democratic Government*, Edward Elgar Publishing, 2011, p. 10.

Accountability Office (GAO), European Court of Auditors (ECA). Their logos are displayed in figure 3.

The International Organization of Supreme Audit Institutions (**INTOSAI**) activates as an umbrella organization for the external government audit community. It offers an institutionalized framework for supreme audit institutions to support improvement and transfer of knowledge, best practices, develop government auditing worldwide and increase professional competences. INTOSAI is an autonomous, independent and non-political, non-governmental organization with special consultative status with the Economic and Social Council (ECOSOC) of the United Nations. It was founded almost 60 years ago, in 1953, in Havana, Cuba, at the initiative of Dr. Emilio Fernandez Camus. INTOSAI groups together the Supreme Audit Institution (SAIs) of 190 countries, full members, and four associate members, and it is listed as a support organisation of the United Nations. The INTOSAI Regional Groups are EUROSAI, OLACEFS, AFROSAI, ARABOSAI, ASOSAI, PASAI and CAROSAI. **EUROSAI** (the European Organisation of Supreme Audit Institutions) is one of the Regional Groups of the International Organisation of Supreme Audit Institutions (INTOSAI).

The U.S. Government Accountability Office (**GAO**) is known the congressional investigative arm or "watchdog"; GAO supports the Congress in meeting its constitutional responsibilities and helps improve the performance and accountability of the federal government for the benefit of the American people.

The European Court of Auditors (**ECA**) is an institution of the European Union (EU), which audits the accounts of EU institutions and is composed of one member from each EU member state. The main role of the Court is to externally verify if the budget of the European Union has been implemented correctly, if EU funds have been spent lawfully and with sound management. The mission of the Court is to carry out audit of accounts, and to examine the legality and regularity of transactions, as well as the sound financial management (performance audit). Consequently, the Court must check the legality and regularity of transactions, verifying the compliance of budgetary operations with the treaties and regulations and with generally applicable accounting norms. It must also audit the budget management, examining to what extent the budgetary intervention meet established objectives and analysing the costs[6].

[6] García Crespo, Milagros, *Public Expenditure Control In Europe: Coordinating Audit Functions In The European Union*, Edward Elgar Publishing, 2005, p. 135

All these organizations have their own standards that are accepted by their members. INTOSAI has published generally accepted principles of performance auditing in its implementation guidelines. The ISSAIs, International Standards of Supreme Audit Institutions are a benchmark for all auditing public entities (External Audit Standards for public entities). In the United States, the federal Government Accountability Office (GAO) has issued the "yellow book", the collection of the Generally Accepted Government Auditing Standards (GAGAS). Similarly, In E.U. the European Court of Auditors (ECA) has developed a "performance audit manual" for its audits of the sound financial management of the European Commission and the programmes funded through the EU budget.

The International Organization of Supreme Audit Institutions **(INTOSAI)**	European Organisation of Supreme Audit Institutions **(EUROSAI)**	USA Government Accountability Office **(GAO)**	European Court of Auditors **(ECA)**

Figure 3. The system of the most prominent external audit organizations.

3. The famous "Three E's" of the performance audit

Most organizations pursue certain missions, certain objectives; they can be clearly stated in a formal document, or just implicit, understood goals. For instance, a municipality office can have as mission a cutting-edge management, reflected in accomplishing public tasks set out in legal provisions, ensuring professional customer service, creating an encouraging climate and favourable conditions for realization of the collective needs of the community, formulating the manner for execution of fundamental tasks in the form of established procedures and instructions, making use of implemented management processes to effective accomplishment of all tasks facilitating buoyant development of the municipality, and thus increased quality of life for

local community, and creating the image of the municipality premised on building relationships with varied interest groups[7].

"The three Es" are important notions that help out the auditor when formulating objectives of his mission and outlining the general direction of the audit. With the help of these notions, the auditor can describe processes, organise judgments and observations, and to measure and clarify. The model is based on the postulation that it is possible to set up activities in chains and to identify how these activities influence each other as causes and effects. Another postulation is that organisations have established goals that they want to reach. In the model inputs are used to produce outputs that will have an effect on the achievement of the goals. Economy is concerned with the inputs, efficiency with how these inputs are transformed into outputs and effectiveness with the effects generated by the outputs.

Performance auditing comprises:

a) audit of the economy of administrative activities in accordance with sound administrative principles, practices, and management policies. What does it mean **Economical?** It means to purchase appropriate resources (inputs) at least cost, i.e. spending less. *Example*: Whether construction of a public building is completed on time, at least cost.

b) audit of the efficiency of utilisation of human, financial and other resources, including examination of information systems, performance measures and monitoring arrangements, and procedures followed by audited entities for remedying identified deficiencies; What does it mean **Efficient?** It means to maximize the output for any given input and/or to minimize the input for any given level of output, i.e. spending well. *Example*: Number of patients treated per dental chair/dentist.

c) audit of the effectiveness of performance in relation to attainment of the objectives of the audited entity and audit of the actual impact of activities compared with the intended impact. What does it mean **Effective?** It means to attain objectives or other anticipated outcomes of programs, operations or activities. *Example*: Whether treatments provided by a community medical service improves population's healthiness.

The three Es cannot nevertheless be assessed separately from each other. When assessing the effects it is compulsory to take into

[7] Wereda Wioletta, Raczkowski Konrad, *Contemporary challenges in the process of management in organization of the future*, Studio Emka 2012, Poland, p.195

consideration the cost of the inputs used to create the effects and, likewise, when assessing economy the utility of the inputs for generating the outputs has to be considered.

Some organizations are integrating now also environmental/ecological considerations in the Performance Audit Work. We suggest integrating into the input-output model the fourth factor, which is **Environmental Sustainability. So, the 3 E's become 4 E's.** Integrating Environmental considerations into ongoing organizational activities means to maintain the factors and practices that contribute to the quality of environment on a long-term basis. According to Robert Goodland[8], a strong Environmental Sustainability requires maintaining separate kinds of capital. Thus, for natural capital, receipts from depleting oil should be invested in ensuring that energy will be available to future generations at least as plentifully as that enjoyed by the beneficiaries of today's oil consumption. This assumes that natural and human-made capitals are not perfect substitutes. On the contrary, they are complements at least to some extent in most production functions.

Performance audit is not excessively subject to specific requirements and expectations, being more flexible in its choice of subjects, audit objects, methods, and opinions, comparing to financial audit that apply relatively fixed standards. Performance audit is not a regular audit with formalized opinions, and it does not have its roots in private sector auditing. It is by nature comprehensive and open to judgments and interpretations and uses many investigative and evaluative methods.

The purpose of performance auditing can be: audit of achievement of objective, audit of effects, measuring economy audit, focusing mainly on the goals of the organisation/programme. As academic base, auditors should master many fields, like: Economics, finance, accounting, political science, sociology, law, engineering, IT etc.

For predominantly operating and economic measures, the basic financial mathematical techniques should be known, such as capitalised-value method, annuity method, and internal interest rate method. In normal project management assessment, practical methods are used, such as cost comparisons, amortization calculations, or cost/benefit analyses. When dealing with big national/multinational projects involving a substantial amount of funds auditors may apply methods which evaluate especially the costs and benefits.

[8] Goodland Robert, *The concept of Environmental Sustainability*, Annual Review of Ecology and Systematics, Volume 26, 1995, p. 15

The steps made for carrying out a performance audit can be:

a) Audit of achievement of goal – assessing the degree to which actions have achieved projected goals;

b) Audit of effects – settling on whether and to what extent the measures were "effective" and therefore appropriate for achieving the goal;

c) Economy audit examines whether the measures were implemented with budgeted resources – implementation economy audit (e. g. highway construction) and whether the measures, taken as a whole, were economical with respect to the definition of goal (e. g. to improve income in a certain region by building a highway – the highway construction alone is not decisive) – measure economy audit.

4. Performance audit in the European Union

Europeans are pioneers and developers of the field of audit. The term of "audit" developed during the reign of Queen Elizabeth I of England, who, in 1559, attached to the post of Exchequer the title of Auditor, who controlled the public expenditure.

In 1807, Napoleon Bonaparte created the Courts of Accounts (*fr. Cours des comptes*), as external auditor of the public funds. The crypt of French Empereur from "Dôme des Invalides", in Paris, is surrounded by a covered gallery with ten bas-reliefs in white marble of 4 m by 2 m, underlining the major creations of imperial rule; among them one can admire "*fr. La Légion d'honneur, Les grands travaux publics, Le Code Napoléon; L'Université"* and "fr. *La Cour des comptes*", recognizing the role of this institution to the progress of France. In the XXth century, many countries have copied standards of the prestigious bodies-National Audit Office (United Kingdom) or *Cour des Comptes* (France).

State audit long preceded the emergence of the modern democratic states, but performance audit is a recent development, as a large scale, self-conscious distinct practice dates back since the late 1970's. Responsibility for the use of public funds is of crucial importance to any democratic government. At the national level this generally involves the executive government accounting to elected representatives in Parliament for its oversight of taxpayers' money. State audit institutions have a vital contribution to provide independent and objective information, assurance and advice to Parliament about the accounts presented by the Executive.

The most prominent organization involved in performance audit is the **European Court of Auditors (ECA)**; although it has no judicial function,

Court's decision is the basis for the European Commission decisions. The European Court of Auditors is the EU Institution established by the Treaty to carry out the audit of the EU finances. As the EU's external auditor it contributes to improving EU financial management, promotes accountability and transparency, and acts as the independent guardian of the financial interests of the citizens of the Union.

In 2011, the ECA begun to methodically examine the implementation of recommendations by auditees. Starting from 2012 the ECA will be able to report on the degree to which recommendations are implemented in practice and lead to improvements. In its audit strategy for 2009-2012, The Court aims to: maximise the overall impact from audits; and increase efficiency by making best use of resources.

With a budget of 144 million euro in 2012, the European Court of Auditors has three main outputs:

– annual reports, comprising mainly the results of financial and compliance audit work on the European union budget and European Development Funds (EDFs);

– special reports, published throughout the year, presenting the results of selected audits of specific budgetary areas or management topics. These are mainly performance audits;

– opinions on draft legislation with an impact on financial management, and position papers on other issues at the ECA's own initiative.

Table 1.

Synthesis of ECA's activity in 2011

Number of reports and opinions	2007	2008	2009	2010	2011
Annual reports on EU budget and EDFs	2	2	2	2	2
Specific annual reports on EU agencies and decentralised bodies	29	29	37	40	42
Special reports	9	12	18	14	16
Opinions and other output	9	5	1	6	8

Source: European Court of Auditors-*Annual Activity Report 2011*, p. 10.

In 2011, ECA carried out 16 special reports throughout the year, covering performance and compliance audits of specific budgetary areas or management topics of its choice. In 2011 the ECA adopted 16 special reports on a range of topics. For instance, one of the performance audits performed last year has had as a purpose the appraisal of the effectiveness of the school milk and school fruit schemes (10/2011), which assessed whether the EU subsidies have a direct impact on the beneficiaries' consumption and if the schemes are likely to meet their educational objectives and influence future eating habits. These EU schemes aim to encourage children to eat healthily by consuming dairy products and fruit and vegetables, and to contribute to improving the market for these products.

Since 2008, the ECA has developed gradually a set of key performance indicators (KPI s) aiming to assess key elements of the quality and impact of the ECA's work, paying special attention to the opinion of key stakeholders, and the efficiency and effectiveness of its use of resources.

The European Union's administration is not in short of criticisers, who accuse it of lack of transparency. For instance, in 2008, Tim King[9], from European Voice, underlined that ECA has, for the 14th year running, refused to give a clean bill of health to the EU's spending. The auditors of ECA estimated that, in 2007, at least 11% of the €42 billion spent on cohesion should not have been paid out because the EU's rules were not complied with. Spending on cohesion, which accounts for 37% of the budget, had an error rate of more than 5%. The Commission urged the member states to do more prevent and correct errors in the management of EU money.

5. Case study: Implementation of the performance audit function in Romania

The implementation of performance auditing in the public sector has been one of the more important new additions to the traditional auditing role (financial audit).

The need for development originates from the status of 'EU candidate country'. In addition to the adoption of the acquis communautaire

[9] King Tim, *EU fails its spending audit, again*, European Voice, 10.11.2008

preparations had to be made to ensure that the legislation is applied in the same way as in the Member States.

Until the year 1999 in Romania there was no regulations on internal audit; with the application of International Accounting Standards, internal audit has been implemented for the first time since 1989, by Order no. 1267/2000, approving the minimum standards of internal auditing. Internal audit was required from fiscal year 2001 onward for the entities whose financial statements were financially audited, such as: national companies, banks, insurance and reinsurance firms, brokerage firms, etc.

With all the shortcomings inherent in any beginning, entities have complied gradually with the new auditing rules, and organized internal audit departments. Another legislative initiative was the Ordinance no. 75/1999, regulating the financial audit, amended by Law no. 133/19.03.2002 and Government Ordinance no. 67/29.08.2002. According to three acts, internal audit activity is objective examination of the whole of the economic entity in order to provide an independent assessment of risk management, control and management processes it. The Chamber of Financial Auditors of Romania (CAFR) has fully assimilated the International Standards on Internal Audit.

The Law no. 672/2002 on public internal audit[10], defined in Article 2, the internal audit activity as "an activity functionally independent and objective assurance and advice designed to add value and improve operations of the public, the public entity to help meet their targets through a systematic and methodical approach, evaluates and improves the efficiency and effectiveness of risk management, control and governance processes". The Law no. 191/2011 has amended the Law no. 672/2002 on the public internal auditing.

The amending deals with the definition of several specific terms, with the recruitment of the internal auditors, the domains they shall cover, the recognition of their professional competencies and the issuance of their attesting certificate, with the attestation of the existing internal auditors and with several other aspects specific to the amended matter.

One of the types of audit performed by public auditors is the performance audit, which, in the vision of art. 14 of the law no. 672/2002,

[10] *Law no. 672/2002 on public internal audit in Romania amended by the Law no. 191/2011*, published in Official Monitor of Romania

is: an assessment of depth of management and internal control systems, in order to determine whether they operate economically, effectively and efficiently, to identify deficiencies and make recommendations for their correction.

The Court of Accounts is the external public auditor of Romania. It has the role to examine the actions of the people responsible for the public management, informing the taxpayers on how the authorities used the public funds. The Court of Accounts exercises control over the formation, administration and use of the state and public sector financial resources. The Court of Accounts establishes and submits each year, to the Parliament, a report on the nominal accounts of the consolidated general budget of the expired budgetary exercise, also including the found irregularities.

The Court of Accounts carries out its activity autonomously and performs three types of audit: financial audit, performance audit and compliance audit (thematic control). They tackle the following issues:

1. whether the accounts accurately present, in all material respects and in accordance with the applicable financial reporting framework, the financial statements, the results and cash flow for the given exercise – the financial audit;
2. whether a good financial management is being provided – in other words, the performance audit, focused on:
    a. economy – whether the funds allocated to an activity have been used economically;
    b. efficiency – whether the results of the activity were obtained with the lowest amount of allocated resources;
    c. effectiveness – whether the designated objectives were met;
3. whether the operations comply, in all material respects, with the applicable legal and regularity framework – the compliance audit.

According to the 2011 activity program, the Court of Accounts' central and regional structures have conducted a number of 3218 actions, including financial and performance audit missions, control actions, actions to check the carrying out of the measures ordered by decisions, as well as research actions.

Synthetically, the Court of Accounts for 2011 activity results are as follows:

– 2,449 verification actions, out of which: financial audit missions: 1,534, performance audit missions: 302, control actions: 613

– 585 actions to check the implementation of the measures ordered by decisions, out of which: research actions: 184.

Only 9 percents of the activities performed by the Court of Accounts' represented performance audit in 2011, which is a rather small percentage, that should be increased in the following years.

Figure 4. The graphic of the actions carried out by the Romanian Court of Accounts in 2011.

Source: Romanian Court of Accounts – *Annual Activity Report 2011*, p. 13.

The audit missions and control actions carried out by the Court of Accounts in 2010 at the 2751 entities have identified cases of non – compliance with the legal regulations, deviations and irregularities that have resulted in the failure to monitor and collect certain budgetary revenues or have generated damages. The evaluation of the deviations found is as follows:

Table 2.

Actions carried out by the Romanian Court of Accounts in 2010.

Explanations	m.u.	The evaluation of the deviations found					
		-the estimated amount	subsidiary income	TOTAL	of which:		
					Financial audit	Performance audit	Control
A	B	1	2	3=(1+2)=(4+5+6)	4	5	6
Additional incomes	mil. lei	1,779.43	632.37	**2,411.80**	492.48	249.50	1,669.82
	mil. euro*	422.68	150.21	**572.89**	116.98	59.27	396.64
Damages	mil. lei	736.89	19.13	**756.02**	464.40	59.35	232.27
	mil. euro*	175.04	4.54	**179.58**	110.31	14.10	55.17
TOTAL	mil. lei	**2,516.32**	**651.50**	**3,167.82**	**956.88**	**308.85**	**1,902.09**
	mil. euro*	**597.72**	**154.75**	**752.47**	**227.29**	**73.37**	**451.81**

** The average exchange rate leu/euro in 2010, 4.2099, was used.*
Source: The National Bank of Romania

Source: Romanian Court of Accounts-*Annual Activity Report 2010.*

From the data presented above, we can see that the damages caused by deviations found with the help of performance audit assignments in 2010 amounted at 14 million euro, which is not a very big sum, but it is a novelty for the Romania's auditors. The total of measures ordered in 2010, was 14,866, out of which 11254 as a result of financial audit missions, 291 as a consequence of the performance audit missions and 3321 as a result of compliance audit missions.

In 2005, the Romanian Finance Ministry has adopted 25 standards of internal control, in fact principles generally accepted by the European Commission, concentrated on five domains: control, performance and risk management, information and communication, control activities, auditing and evaluation.

6. Conclusions

Generally, performance audit is a new function of the management, helping stakeholders to take the right decisions on an objective basis; it plays as a tool to implement a sound financial management of the organizations, no matter if they are private companies or public ones, such as those activating under the umbrella of the United Nations or of the European Union. It is not just a instrument like financial audit that can be easily standardized, it is a useful tool that grants information and feedback for organization development. Implementing the performance audit of public funds is a matter of respect for tax payers and should be extensively introduced in all the institutions on public budget. For a country like Romania, relaunching an appropriate auditing practice has been an essential step towards a better public management.

In the future years, developing the institutional framework, and boosting up the role of performance audit is a key for progress, transparency of public expenditure, bettering the perception over the macroeconomic environment and consolidating the democratic values.

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BUSINESS WOMEN ENTREPRENEURSHIP IN THE NEW ECONOMY

Claudia IONESCU[*]

Abstract. *The idea that we need a "new economy" is that the entire economic system must be radically restructured taking into considerations the new global changes – economic and financial crisis.*
Also we will see what "changing the system" means is a matter of considerable debate.
The paper demonstrate that the woman is going to become an important manager in business and in the same time, a voice able to be headed in all places of the world. As study case I'll present Romanian business women.

Keywords: *Business, change, entrepreneurship, new economy, woman.*

1. Introduction

The idea is that we need a "new economy" – that the entire economic system must be radically restructured if critical social and environmental goals are to be met. Most of the projects, ideas and research efforts have gained traction slowly and with little notice. But in the wake of the financial crisis, they have proliferated and earned a surprising amount of support – and not only among the usual suspects on the left. As the threat of a global climate crisis grows increasingly dire and the nation sinks deeper into an economic slump for which conventional wisdom offers no adequate remedies, more and more people are coming to realize that it is time to begin ***defining, demanding and organizing*** to build a new-economy movement.

The term "new economy" has begun to spread into public use in diverse areas may be an indication that the movement has reached a critical stage of development – and a sign that the domination of traditional thinking may be starting to weaken. Although, what "changing the system" precisely means, it is a matter of considerable debate.

Several initiatives have begun to deal systematically with fundamental problems of vision, theory and longer-term strategy. "For the most part,

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advocates for change have worked within the current system of political economy," says Speth, a former adviser to Presidents of USA – Carter and Clinton, onetime administrator of the United Nations Development Programme. "But in the end", Speth declares, "This approach will not succeed when what is needed is transformative change in the system itself"[1].

2. Theory – Entrepreneurship in the new economy

Along with the rapid expansion of small and medium-size businesses committed to building the new economy appeared a sense of community and shared mission. Staff, managers and owners at many of these companies are finding more opportunities to share ideas and pool resources with like-minded professionals.

Apart from the central issue of how political power might be built over time, three in particular are clearly daunting: first, many new-economy advocates concerned about global warming and resource limits hold that conventionally defined economic growth must be slowed or even reversed. In theory an economic model that redistributes employment, consumption and investment in a zero-growth or reduced-growth system is feasible, but it is a very hard sell in times of unemployment, and it is a direct challenge to the central operating principle of the economic system. It is also a challenge to the priorities of most elements of the progressive coalition that has long based its economic hopes on Keynesian strategies aimed at increasing growth.

3. Discussions – A related problem concerns the labour movement

A related problem concerns the labour movement. Many new-economy advocates hold progressive views on most issues of concern to labour. So, new-economy efforts will ultimately pose much more radical systemic challenges than many have contemplated. Nonetheless, new-economy advocates are beginning to tap into sources of moral concern similar to those of the early environmental movement.

According to UNDP, women are responsible for 66 percent of the world's work but earn only 10 percent of the income and own just 1 percent of the world's land. Most women throughout the world are relegated to

[1] http://www.thenation.com/article/160949/new-economy-movement

low-skilled, low-wage jobs. For many of these women, their long history of marginalization is a cycle that is hard to break.

"There is rising awareness across the world that women are becoming an undeniable economic force. Women are increasingly at the center of the global economy. According to a survey of women by Boston Consulting Group, women are the world's largest and fastest growing market, controlling or influencing three-quarters of the $18 trillion in global consumer spending. A country's competitiveness correlates positively to those who possess greater gender parity, resulting in better economic performance, competitiveness, and greater prosperity"[2].

There is a growing body of research and data that correlates high yield outcomes to women who run small and medium-sized businesses and there is a strong correlation to increased GDP. Globally, there are more than 200 million women entrepreneurs including those in rural areas, townships and villages who open small businesses or cooperatives to generate income. Based on this evidence, adding more women to the labour force could provide a substantial boost to GDP growth and per capita income.

In Europe right now we are witnessing huge tremors in the fabric of a Union that was on a certain trajectory for the past few decades, and now seems destined for another. The global financial system continues to defy expectations and move in new and unusual ways. As analysts try to predict the future, many of us are wondering – what will come next?

4. Woman in business

Women entrepreneurs face obstacles due to poor access to business opportunities, credit, financial markets, and the knowledge of running a business. Research and anecdotal evidence also show that women lag far behind men in access to credit, despite the fact that they are better at paying back loans. By empowering women, the whole family, and the world's economy wins. The World Bank has documented that women tend to invest a higher portion of their earnings in their families and communities than men do.

"Narrowing the gap in employment between men and women in emerging economies could raise incomes as much as 14 percent by 2020, and 20 percent by 2030," remarked U.S. Secretary of State Hillary Clinton at Second Annual Women in the World Stories and Solutions.

[2] http://www.apec.org/Press/Features/2011/0905_empowerwomen.aspx

Ms. Weili Dai, co-founder of Marvell Technologies Group recognizes that "technology is not a silver bullet" and went on to describe the possibility of how a woman in developing world can connect to the global economy without leaving her village or hometown. For example, Marvell Technologies Group has been working for several years with China Mobile and its more than 600 million subscribers to bring affordable smart phones and tablets to women entrepreneurs throughout China. Furthermore, this connectivity delivers information to create a more enlightened and open society better exposed to the idea of women in non traditional roles.

Ms. Weili Dai is hopeful that more women will be attracted to these sectors. "Fortunately, technology is not as 'boring' as it used to be and is now an incredible tool for creativity", Dai said in an interview.

The female mind can bring a unique perspective to problem-solving in traditionally male-dominated industries such as business, engineering, or government, she added. Dai firmly believes that APEC economies can and must develop environments that engage women and leverage their natural talents.

Because I am female and I have been working in regional development field I may say that we have "the certitude that each Member State of the European Union has been implementing regional policy according to a historical evolution, the quality of its political leaders and of the responsible institutions"[3].

Talking about leaders, we also have to take into consideration the managers and it is useful to have in mind a full picture. According to Mark Anderson[4] the challenges for managers and for leaders are describe in table no. 1:

Table 1

Managers	Leaders
Follow rules	Follow instincts
Focus on getting things done	Focus on getting the right things done
Side with safety	Side with risk
Focus on delivering today	Focus on articulating tomorrow

Source: Mark Anderson, *The Leadership Book*, Pearson Education, 2010, Great Britan, p. 10.

[3] Claudia Ionescu, N. Toderas, *Regional development policy*, Tritonic Publishing, Bucharest, 2007, p. 144

[4] Mark Anderson, *The Leadership Book*, Pearson Education, 2010, Great Britain, p. 10

Management and the leadership style are influenced by behaviours and reflect the cultures. According to PhD Paula Caligiuri[5] the leadership skills are global and there are "5 characteristics: goal-oriented tenacity, managing complexity, cultural sensitivity, emotional resilience, and ability to form relationships. These are the foundation of a strong leader".

4.1. The Hansel and Gretel story[6]

What can we learn from this old fairy tale when it comes to our marketing and our pricing?

- **Be sure that your offerings are made of white pebbles, not breadcrumbs.** Offerings need to have a long shelf life and the versatility to be reusable or repackaged in various ways. ***Experiences*** *are a great way to connect with your potential clients, so give them great value and then repackage the final offering in a new experience.*
- **Remember that the pebbles (low-priced or free offerings) always lead the consumer to bigger offerings and bigger experiences such as the vast treasure.** Be sure that the offerings are ***logically stepped*** *up so that the customer/client can see value in each offering and the increased value in each price increase.*
- **Don't be the wicked stepmother.** Don't lead your potential clients into the woods and leave them there to get eaten by a witch. ***Guide*** *your potential customer from one offering to the next (up the pricing chain),* ***making your website and marketing materials CLEAR about the path of increased value.***
- **When you only have one offering (i.e. the witch who wanted to eat the children) you have to be careful not to get burned and die!** All offerings can be and should be packaged in various ways. Every product can be made into at least 5 product variations, allowing your income options to vary. For example, if you have just written a book, it can become any (or all!) of the following 8 products / offerings:
  - Paid speaking gigs
  - Audio Recordings

[5] Charlenle M. Solomon & M. S. Schell, *Managing across cultures***,** Mc Graw Hill, 2009, pp. 291-293

[6] https://womenpresidentsorg.wordpress.com/2012/03/30/pricing-in-our-new-economy/

- Coaching
- Print Workbook
- Online Workbook
  - Live Workshops
  - Telephone Workshops
  - eBooks.

Do this for ANY product to increase income streams simply, using the same content and services.

- **Pay attention to the conversations around you (i.e. the parents planning to "lose" the children in the woods) so you can always be prepared.** What are people in your social networks saying they need? How are others pricing similar products? What are the latest (and predicted) trends and how can you plan to be in the forefront of that trend AND have your offerings be priced appropriately? Start gathering those white stones *now*.

From[7] mothers juggling babes and business at the kitchen table to the 'one – woman show' running a restaurant or retail outlet to the woman at the helm of a large business there's a **stampede of women creating new business**.

Born from seeds of **initiative and self-reliance** this powerful movement is committed to creating a **business culture based on our values** rather than the predetermined values of the existing business structure and culture. We'll do it our way…. whatever that way is! Whilst this **'new economy'** is exciting, edgy and offers women **enormous opportunity** it also contains **greater risk and insecurity.**

4.2. What[8] is new economy and why is it feminine?

Let see what the Key Components of the New Economy are:

- Information and knowledge based – we are selling ideas and services;
- Internet based – the most effective marketing tools for selling ideas and services;
- Personal brand based – it is as much about 'us' and the journey we've taken as it is about our ideas for *x*, *y*, or *z*.

[7] http://www.shebusiness.com/2011/10/a-new-enterprise-for-a-new-economy-2/
[8] http://www.newfemininefinance.com/category/new-economy/

Let revised what is **the knowledge economy and** why is this 'feminine' economy? Well, if you listen to any of the great creativity theorists. Another way of looking at the archetypal constructs of masculine and feminine is that the masculine is the force of *expansion* in the universe, hence everything that we 'see', and the feminine is the *contraction*, such as the invisible forces of gravity.

And what is more invisible than the realm of ideas? Information businesses require a different type of explanation, a different type of understanding.

4.3. Internet-based businesses

Internet means flexible. It means home (if that's what you choose), or whatever you really want. At long last! It is a way for women to incorporate their family, home-lives, with caring for the physical and emotional bodies *and* running a successful business or career.

4.4. The age of the personal brand

This is probably the most interesting and sensitive area of the new economy. At one level it is about bringing the personal (who we **are**, and how we **feel**) into the professional – and what is more feminine than that?

At another level, a personal brand can mean bringing forth the deepest and most complex aspects of a person's being, enabling them to make a powerful stand for whatever they believe in, modelling whatever growth and development they have accomplished – and so for me, the question is just – how deep do you want to go?

By far the most effective personal brands we can see are those that incorporate not only the surface aspects of a woman's life, but also the battles she has fought and the depths she has mined. We can call it soul, spirit, or whatever source of wisdom we choose to believe in, being a powerful personal brand in today's economy means mining the depth of who we are, and bringing that forth in a way that is compelling and of value to those around us.

4.5. What are the main directions for a successful business in the new economy?

4.5.1. To understand that we have a unique role in this world and we are here to play it

How can we do? First we have to connect with our vision for life and business and uncover our life's mission and purpose. Also we have to set in place the feminine foundations and lifestyle that bring us most happiness and joy.

4.5.2. Designing our own vocation – how?

- Understanding the journey we have taken to date, and seeing how your personal evolution has served you in stepping into your fullest potential,
- Understanding how your all your gifts, skills and experience come together within the context of the new feminine economy,
- Translating your passion into a practicable and purposeful mission and vision.

4.5.3. Building our New Paradigm Business Model

- Learning how to package and sell your information and services in the new economy,
- Building a robust and sustainable business model that harnesses cutting-edge innovation in business and finance,
- Getting a clear and coherent picture of the type of person you are best suited to work with,
- Understanding all the systems and structures you need to have in place in order to create a thriving business,
- Uncovering your own unique brand, and building this in the new economy.

Also we have to pay attention to "the Time Value of Money that is a way of making Decisions in the face of Opportunity Costs. A you have various options of investing funds with various returns, the Time Value of

Money can help you which options to choose and how much you should spend, given alternatives"[9].

4.6. After the previous steps what are our expectations?

We have to have:

- **A full business plan**, including mission statement, vision, analysis of the market opportunity, product and services, and financial model;
- **A full marketing plan**, including ideal client and target market analysis, a route to market, and internet marketing strategy;
- A plan for the creation of all **business structures**, including incorporation finance, insurance, legal and internet structures;
- An understanding of what it means to **'manifest from the feminine'**, and how the structures you create in your life contribute to your business success;
- A plan for your **general health, wealth and well-being** that will bring you the ultimate joy, happiness and freedom.

5. Conclusions

As Stephen R. Covey[10] said with "any other business, we're changing market realities".

We'll be looking at the question of how we can begin creating a business in the new economy and use the opportunities that are close to us. We'll be looking at why needing to know who we are, what we stand for and what our ideas are just as important as learning the ropes in terms of the systems and structures needed to create a thriving business.

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